ANALYSIS OF GHQ-12 DATA COLLECTED FROM ANTARCTICA EXPEDITION

PROJECT REPORT

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Debdulal Dutta Roy

Psychology Research Unit
Indian Statistical Institute
203, B. T. Road
Kolkata – 700 108

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ABSTRACT

GHQ-12 is a self-reported questionnaire with 12 items in order to gauze present psychiatric disturbances of the informant. Prior studies noted psychiatric problems in the people who stayed in the Antarctica for prolonged period. Current study examined changes in GHQ-12 scores in association with some physiological parameters in different months in order to understand psychological and physiological adaptation process occurring in the human system across months in the Antarctica. Besides few environmental parameters were taken into consideration in this study.

The project has three objectives – (a) to examine changes in different environmental parameter (2) to examine changes in physiological and psychological parameters and (3) to examine relationship between physiological and psychological parameters across months. Data of six environmental parameters (visibility, direction of wind movement, wind speed, temperature, sea and station level pressure) were collected across eight different periods in different months from January to December. Likewise physiological (body weight, total body water, basal metabolic rate and galvanic skin response) and psychological data (psychological distress and life events) were collected from randomly selected expeditioners across months.

Results showed erratic behavior of environmental parameters. ANOVA with repeated measurements revealed significant mean differences in the environmental, physiological and GHQ-12 scores across the months. No significant synoptic variation in environmental parameters was found. Results noted significant correlation coefficient between physiological and psychological parameters irrespective of months. As expected GHQ-12 was positively related to body weight, total body water, basal metabolic rate and was negatively related to galvanic skin response. MANOVA revealed that less psychological distressed respondents significantly possessed high body weight, total body water and basal metabolic rate than more psychological distressed respondents. More psychological distressed group possessed significantly high GSR than less psychological distressed group.

CHAPTER: 1

INTRODUCTION: SETTING OBJECTIVES

Two hundred million years ago Antarctica was attached to Africa, Australia, India, New Zealand and South America forming the super continent, Gondwana land. Forces within the Earth affecting the crust caused these continents to separate and drift apart. Thirty million years ago the continents, as we know them today, reached their approximate present positions. Antarctica is like a different planet on earth. She is owned by nobody. She is the core of Gondwana land, the first land to form on earth. Somewhere deep in her frozen land, lay the worlds very first rock. She is neither flat nor very snowy. Instead, Antarctica is a mountainous desert.

It is the last continent to be explored and exploited – the continent about which still least is known – has many unusual, interesting and beautiful features. Antarctica is very important to contemporary society because it represents the last place that nobody owns – the last frontier – not only in a physical, adventuring sense, but also on an emotional, intellectual plane. Forty-three nations have agreed to cooperate in this region in the interests of peace and science. A region of the world where the driving values are associated with conservation and adventure. It is an icon of the unspoiled, where, the pure waters and atmosphere recharges and revives the world's ecosystem. Antarctica is recognized as an important region for research on the state of global environment and ocean systems, which control the very sustenance of mankind on earth.

The first Indian Antarctic expedition with support of the Department of Ocean Development was set up on 24th July 1981, and within six months of its creation, it organized the first scientific expedition to the Antarctica. A 21-member team, drawn from seven different institutions, with Dr. S.Z. Qasim as its leader left for Antarctica on 6th December from Goa and successfully landed on the frozen continent on 9th January, 1982. After a stay of 10 days on Antarctica, the expeditioners returned to Goa. During the stay on Antarctica, as also during the sea cruise, substantial amount of scientific work was done on meteorology, glaciology, geomagnetism, geology, biology, radio wave propagation, and pollution studies and also on physical, chemical, biological, geological and geophysical oceanography. The first permanent Indian station in Antarctica named *Dakshin Gangotri* (DG) was constructed during the third Indian expedition (1983-84). DRDO (Defense Research and Development Organization) played a pivotal role in commissioning of this station. For the first time, 12 persons carried out scientific studies during the winter period in this station. The DG station was abandoned in 1990.

Antarctica is a land of extremes - the highest, driest, coldest, and windiest continent. With all islands and ice shelves Antarctica is 13,661,000 km^2 - about twice as big as Australia. For comparison, Australia is 7,686,855 km^2, United States is 9,363,132 km^2. With a very low snowfall most of the continent is technically a desert, with the icecap containing almost 70% of the world's freshwater and 90% of the world's ice. Huge icebergs break off each year from the floating ice shelves and half of the surrounding ocean freezes over in winter, more than doubling the size of the continent. Even though the continent holds 70% of the world's supply of fresh water it's as dry as the Sahara as there is very little precipitation in Antarctica. The temperature prevailing in the continent is on an average ranging between -30^oC and -50^oC in winter and around 0^oC to -10^oC in summer. Johnson (1985) found that average temperature is -50^oC on the polar plateau and -15^oC in the coastal areas. This is the windiest continent due to very high wind speed. Kopper (1995) reported variation of wind speed from 12 to 21 knots. Besides the above, Antarctica is very stress provoking due to glacier, ice crevasses and frequent avalanches. Environmental changes in the Antarctica are unpredictable, as they do not follow definite pattern across the months and across the years too. Therefore, it is important to study various parameters of atmospheric changes in the Antarctica across the months. *First objective of this study was to examine changes in different atmospheric parameters in Antarctica. These parameters are visibility, temperature, direction of wind movement, wind speed, sea level and station pressures.*

1.1 ATMOSPHERIC CHANGES

Since, Antarctica lies in the 66^0 S latitude, the Frigid Zone, the amount of insolation (incoming solar energy intercepted by the Earth) received is very little due to extremely low angle of incidence of the sun's rays. Also during a part of the year, the sun's rays are not received at all. Insolation has significant influence on sustaining the general circulation of the atmosphere, i.e. visibility, temperature, direction of wind movement, wind speed, sea and station pressure.

1.1.1 Visibility

Visibility is defined in various ways. It means the degree of clearness of the atmosphere. It is a measure of the ability of radiant energy to evoke visual sensation. It is sometimes defined as the greatest distance toward the horizon at which prominent objects can be identified with the naked eye. Deterioration of visibility in the Antarctica is due to fog and blowing or drifting snow (Joshi, 1995). Poor visibility is stressful to the expeditioners as their explorations will be intervened and air operations for the logistic supports could not be provided. Joshi (1995) noted better visibility (visibility at 3 kilometers) in January (29%), and December (56%) than February (12%). He classified visibility level into 2 categories — as greater than 3 kilometers but less than 5 kilometers and at 3 kilometers. His study was based on the findings of summer season in Antarctica. Joshi collected data only for the summer months (December to February) from 0600 to 1800 hrs resulting gap of understanding about changes in visibility level during winter and after 1800 hrs. In considering the limitation of earlier study, the present study focussed attention to visibility levels over all the months of a year and across periods ranging from 0 to 2100 hrs. Instead of longer range of visibility this study considered shorter range. Here length of visibility was classified into eight categories (V1: <50 m, V2: 50m to 200m, V3: 200m to 500m, V4: 500m to 1000m; V5: 1km to 2km; V6: 2km to 4km; V7: 4km to 10km; V8: 10km to 15km.).

1.1.2 Direction of Wind Movement

Wind is named according to the direction from which it blows. For example, a west wind comes from the west, a north wind comes from the north. A wind coming from west blows to the east and a north wind blows toward south. Wind is the movement of air caused by the uneven heating of the Earth by the Sun. In Antarctica, wind movement is very erratic. Koppar (1995) noted that on 80% of the occasions, wind blows from SouthEast quadrant. All other directions put together account for only 11%. Wind direction can be studied with a meteorological angle. They are (a) 0° (from the north), (b) 90° from the east, (c) 180° from the south, (d) 270° from the west (Figure 1.1). Globally, winds move to regulate Earth's

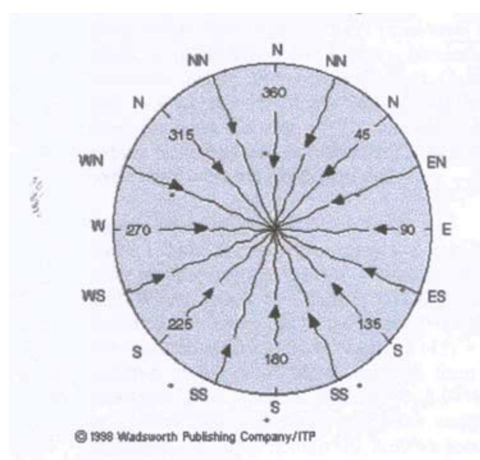

Fig. 1.1 : Meteorological Angles

temperature: cooler air flows towards the equator and warmer air flows towards the poles. Westerlies wind (wind moves from west to east) occurs between 30°S and 65°S. The latitudes in this region have

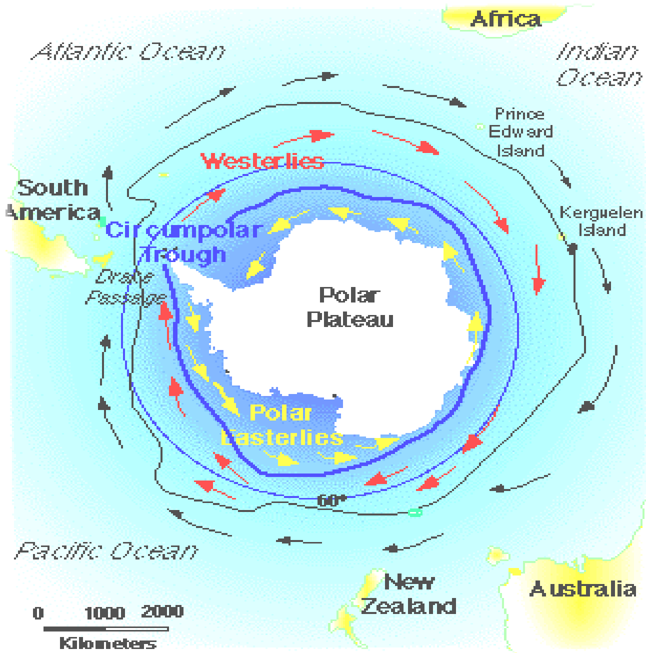

Fig. 1.2 Wind movement

been referred to as the Roaring Forties, Furious Fifties, and Screaming Sixties. This is very close to Antarctica. In Antarctica, easterlies wind (wind moves from the east to west) mainly occurs. Figure 1.2 shows different wind movements around Antarctica.

1.1.3 Wind speed

Wind speed refers to the distance traversed by wind in unit time. In Antarctica, wind regularly blows at 320 km per hour. Koppar (1995) stated that katabatic winds, characterized by high directional constancy but show large variations in speed, are an important feature in Antarctica. Possibly due to the presence of katabatic wind in Antarctica the wind speed is very erratic. He observed that wind speed varied from 12 knots to 21 knots. The month of May was reported to be the windiest month with mean daily speed of 21 knots. For16 days of May, wind speed was greater than or equal to 23 knots. Highest wind speed recorded during 1992 was 80 knots on August 11. Southerly wind being the prevailing wind at Maitri, was studied in particular and the speed on most occasions was reported to vary from 5 to 30 knots. This study emphasizes on the variation of wind speed across 12 months and across 8 time periods and finally it gives importance on studying the interaction between the month and time in wind speed variation.

1.1.4 Temperature

Temperature refers to the degree of hotness or coldness of a body measured on a definite scale. Although the primary source of heat for the earth and its atmosphere is the sun, the heating of the atmosphere is an indirect process. The insolation (incoming solar radiation) absorbed by the earth's surface is converted into heat, which in turn heats the atmosphere by different processes of heat transmission. The three most important processes of heat transfer are radiation, conduction and convection. Besides, there are certain other processes like evaporation and condensation, which play a significant role in the transference of energy from the earth's surface to its atmosphere. Moreover, the adiabatic temperature changes (i.e. temperature changes caused by a change of pressure alone that the rising or falling air is subjected to) occurring in vertically moving air mass work as an additional factor in the heating and cooling of the atmosphere. The atmosphere is heated or cooled by the following processes — partial absorption of solar radiation by the atmosphere, conduction, terrestrial radiation, convection and advection (horizontal convection transport of heat), latent heat of condensation, expansion and compression of the air.

The controls of temperature include those factors that bring about spatial variations in temperature. The followings are some of the more important factors that determine the temperature of a particular place on the earth's surface: latitude, altitude, distribution of land and water, ocean currents, prevailing winds, cloudiness, mountain barriers, nature of the surface, relief, convection and turbulence.

Antarctica is the coldest (-89^{o}C at Vostok, July 21, 1983), highest, windiest driest and iciest continent on earth. Several factors combine to make Antarctica one of the coldest and least hospitable places on the Earth:

a) Antarctica is a continent surrounded by an ocean, which means that interior areas do not benefit from the moderating influence of water.
b) With 98% of its area covered with snow and ice, the Antarctica continent reflects most of the sun's light rather than absorbing it.
c) The extreme dryness of the air causes any heat that is radiated back into the atmosphere to be lost instead of being absorbed by the water vapor in the atmosphere.
d) During the winter, the size of Antarctica doubles as the surrounding sea waters freezes, effectively blocking heat transfer from the warmer surrounding ocean.
e) Antarctica has a higher average elevation than any other continent on the Earth, which results in even colder temperatures.

Koppar (1995) reported that day to day temperature variation at Maitri (Antarctica) is governed by two factors viz., (i) day and night and (ii) warm air advection from northern latitudes in the wake of depressions. Advection of warm air from oceanic areas with approaching depressions vitiates the diurnal variation of temperature. This study emphasizes on the variation of temperature across 12 months and across 8 time periods and finally it gives emphasis on studying the interaction between the month and time in temperature variation. In studying temperature, variation of maximum and minimum temperature was taken into consideration. Koppar (1995) noted highest maximum temperature in January (7.8^{o}C) and lowest in September (-9.0^{o}C) in 1992. In 1992 the minimum temperature was highest in January (-6.4^{o}C) and lowest in August (-31.7^{o}C).

1.1.5 Sea level Pressure

The air pressure at specific sea level is called sea level pressure. The sea level is the position of the air – sea interface. It constantly changes at every locality with the changes in tides, atmospheric pressure and wind conditions. This level is better defined as mean sea level, the height of the sea surface averaged over all the stages of the tide over a long period of time. Air pressure is simply the weight of the overlying column of air. Air is readily compressible. The lowest layer is the most greatly compressed and is therefore is densest. With increase in height, both density and air pressure decreases rapidly. The pressure on 1 square centimeter of the Earth’s surface can be thought of as the actual weight of a column of air 1 centimeter in cross section extending upward to the outer limits of atmosphere. Pressure varies from place to place according to changes in temperature. At sea level, when the temperature increases, the atmospheric pressure decreases. Another factor of variation in pressure is gravitational pull of the Earth. With increase in height, the gravitational pull of the Earth decreases and the density and air pressure decreases. The atmosphere exerts a pressure of 1034 grams per square centimeter (14.7 lb per square inch) at sea level. The atmosphere at sea level on all animals, plants, rocks, etc exerts this amount of pressure. Since air pressure decreases with increasing altitude, at a certain height this balance between outward pressure exerted by the air inside human body and inward pressure exerted by the atmosphere outside is disturbed resulting in unmarked physiological disturbances such as nose bleed, ear bleed, etc.

The sea level of Antarctica varies from place to place. But in average, the sea level is 9,300 feet (2,800 meter). Here, barometric air pressure is on average about 20 percent lower than expected for an elevation of 9,300 feet. This is the result of cold weather patterns in Antarctica that create the effect of "thinner" air at an equivalent elevation. Due to variation of temperature across months, sea level pressure of Antarctica is supposed to vary.

1.1.6 Station Pressure

Station Pressure is the observed pressure recorded at a particular station including all corrections (temperature correction, latitude or gravity correction and instrument correction) except the elevation. In order to make possible direct comparison of pressures recorded at different altitudes, station pressure is converted to sea-level pressure (Lal, 2001).

The air pressure recorded at different weather stations shows a marked variation — a fact that is of significance in the analysis of weather conditions. All the weather changes are closely related to pressure variations. It is customary to believe that high values of air pressure produce clear and stable weather, while low atmospheric pressure brings in bad weather. However, it would be more logical to generalize that a continually rising air pressure is an indication of fine and settled weather, and a steadily falling tendency in the barometer foretells the advent of unsettled and cloudy weather. In other words, despite the fact that air pressure is closely tied to various weather phenomena it is true that the weather at a particular station is largely controlled more by the pressure in adjoining areas, rather than the actual pressure recorded over there (Lal, 2001).

Koppar (1995) has studied pressure at sea-level at Maitri (Antarctica) but there has been no mention about station pressure in his study. The present study, besides dealing with pressure at sea-level, makes an attempt to study the variation of station pressure across 12 months and across 8 time periods. Finally it emphasizes on the interaction between the month and time in station pressure variation.

1.2 PHYSIOLOGICAL CHANGES

Exposure to uncertain environment causes several physiological responses, which are needed to be studied in order to understand physiological adaptation in Antarctica. *Second objective of this study was to examine changes in some physiological responses (Body weight, Basal Metabolic Rate, Total body water and Galvanic Skin response) across both summer and winter months in Antarctica.*

1.2.1 Body Weight

Product of mass of a body with acceleration due to gravity gives the body weight of an individual. When men exposed to the environments colder than body temperature, heat flows from the body core towards the environment, primarily via dry (that is, conductive and convective) heat-loss mechanisms. Furthermore, wind increases convective heat loss from the body surface. All these factors lead to a fall in body temperature. When the body temperature falls below a critical limit, it hinders normal physiological functioning. Thus, exposure to cold environment, with erratic wind in Antarctica, acts as a stress to the expeditioners there. However, to overcome this cold stress, high intake of healthy food is essential which leads to weight gain through the increase of body fat and lean body mass. Body fat increases the tolerance towards cold temperature and increased lean mass increases strength to withstand adverse conditions and decreases fatigue. FAO recommends that calorie requirement should be increased by 3% for each 10^oC fall of mean environmental temperature. Expeditioners may respond to cold stress either by taking enough food, and therefore more calories than the body burns, or by reducing food intake. The reluctance towards food may lead to weight loss. Weight loss may occur because of poor intake of calories (due to loss of appetite, as well as food availability and preparation difficulties), and higher calorie expenditures (due to cold temperature and physical activity).

Total body weight has two components – body fat and lean body mass. Body fat is comprised of two types of fat – essential fat and storage fat. Too little body fat is a health problem because body fat has many important functions. It stores energy; the fat layer under the skin insulates the body and helps maintain body temperature. Fat tissue surrounds vital organs and protects them from shock and injury. It enables nerve transmission and is a vital part of every cell. Lean body weight refers to the weight of structural and functional elements in the cells, body water, muscles, bones and other body organs such as the heart, liver and kidneys. Basically, the sum of everything other than fat in the body. For good health, it is important to have a high proportion of lean weight compared to fat weight. Lean weight produces work and burns food calories.Lean mass varies with age, gender and exercising habits. Lean body weight maintains a fairly constant relationship with total body water. Increase in lean body mass leads to a corresponding increase in BMR of an individual. On exposure to cold environment, the body temperature tends to drop which may which cause disturbances to normal physiological functioning. An increase in lean body mass in this situation will ensure an increase in BMR whereby cold tolerance of the body will be ensured. Thus, it may be assumed that any change in lean body mass indicates one's physiological response to environmental (cold) stress. This paper examined variation in body weight, in body fat percentage, and in fat body weight and lean body weight across twelve months

1.2.2 Basal Metabolic Rate

Basal metabolic rate is the amount of energy produced by a person at complete physical and mental rest, lying comfortably awake in a thermoneutral environment and in the post absorptive state (i.e., 12-14 hours after the last meal). Basal metabolic rate includes energy spent in essential activities like heart beats, respiratory movements, renal functions, muscle tone and transmembrane ion-transports by sodium pump; but it excludes any energy spent in digestion and specific dynamic action. The change in BMR depends upon several factors – Genetics (Some people are born with faster metabolism: some with slower metabolism), Gender (Men have higher BMR due to greater muscle mass and a lower body fat percentage), Age (Due to loss of total muscle mass, metabolism slows with age), Weight (the more one weighs the higher the BMR), body surface area (The greater the body surface area factor, the higher the BMR.), body fat percentage (People with a higher body fat percentage, have a lower BMR), diet (Starvation or serious abrupt calorie-reduction can dramatically reduce BMR by upto 30%.), body temperature (for every increase of 0.5C in internal temperature of the body, the BMR increases by about 7 percent), external temperature (exposure to cold temperature causes an increase in BMR, so as to create the extra heat needed to maintain the body's internal temperature. A short exposure to hot temperature has little effect on the body's metabolism as it is compensated mainly by increased heat loss. But prolonged exposure to heat can raise BMR), glands or hormones (Thyroxin, produced by the thyroid gland, is a key BMR-regulator which speeds up the metabolic activity of the body. The more thyroxin produced, the higher the BMR), pregnancy (BMR rises by about 5% in the first two trimesters and by about 12% in the last trimester of pregnancy. These result from the rise in cell population and in the metabolic rate of both foetal and maternal tissues), Sympathetico-adrenal stimulation (Any stimulation of the sympathetico-adrenal system, e.g., in emotions or on cold exposure, increases BMR by enhancing muscle tone, heart rate, respiratory movements and adrenaline secretion), exercise (Physical exercise not only influences body weight by burning calories, but it also raises BMR by building extra muscle).

1.2.3 Total Body Water

Water makes up about 45-65% of the body weight of a healthy person. It plays a vital role in regulating body temperature, removing waste from the body, carrying nutrients, oxygen, enzymes, hormones and glucose to the cells, carrying away toxins and metabolic waste from the cells for elimination, cushioning joints and strengthening muscles and providing natural moisture to skin and other tissues.

Water is continuously lost from the body during the day through sweat, urine and breathing. The amount of water that is lost depends on factors such as physical activity and climatic conditions. Other factors affecting body water level include illness, medications, hormone changes and poor nutrition.

A major portion of the body weight is made up of water. A small drop below this percentage constitutes dehydration. The percentage varies from individual to individual and depends primarily upon the amount of body fat and age. Leaner people have a greater portion of water to total body weight because fat is basically water free. Total body water decreases with age. In the human cycle, infants have the highest amount of water to total body weight. In a normal adult male, water to total body weight is about 65% and in a normal female, it is about 55%. This is because females have more subcutaneous fat than males. The percentage of water to weight can also be influenced by the health of the individual. A person who is ill, and having trouble remaining hydrated, will experience a decrease in their normal water to total body weight.

As total body water level changes naturally throughout the day, this may affect the body fat percentage readings. First thing in the morning one will be dehydrated and the fluid in the body will be stored in the central trunk area. As the day progresses, this fluid becomes more evenly distributed and eating and drinking will also affect the total body water level. So even though the actual body fat mass will not change during the day, the body fat percentage will, as the total body water changes.

The relationship between total body water and fat-free body weight (lean body mass) is fairly constant; in an adult the total body water is about 72% of lean body mass (Hernandez – Peon, 1961).

During physical work, mental stress, and exposure to climatic extremes, marked disruptions of body fluid balance can occur. This is true in cold climates as in hot. For example, soldiers conducting cold-weather operations are often dehydrated by 3 to 8% of their body weight (Bly et. al., 1950). Several factors are associated with fall in total body water level, and consequently dehydration, during cold exposure. Some of these factors are sweating and increased respiratory water losses as well as cold-induced diuresis. Drop in total body water level can also result from logistic constraints in fluid delivery, problems with freezing of water, reduced thirst sensation and voluntary fluid restriction. The resultant dehydration that occurs negatively influences physical and cognitive performance, as well as thermoregulation and possible susceptibility to peripheral cold injury. Ingestion of glycerol in drinking water might be an effective countermeasure to reduce or delay cold-induced dehydration and associated decrements to perfomance.

From the above discussion it becomes clear that cold environment acts as a stress to which expeditioners to cold regions respond physiologically. Total body water changes in an individual may be assumed to act as an indicator of this physiological response to cold stress. Based on this assumption, it will not be improper to think that the total body water level of expeditioners to Antarctica may reveal a change in the summer and winter months there. The present study thus, makes an attempt to examine whether the total body water level change across months in Antarctica and if at all it changes, then what is the pattern of this change across the cold and relatively hot periods of the year.

1.2.4 Galvanic Skin Response

Galvanic skin response is a change in electric conductivity of the skin caused by an increase in activity of sweat glands when the sympathetic nervous system is active, in particular when the organism is anxious.

GSR is a simple and reproducible method of capturing the autonomic nerve response as a parameter of the sweat gland function. Physically GSR is a change in the electrical properties of the skin in response to different kinds of stimuli. Any stimulus capable of an arousal effect can evoke the response and the amplitude is more dependent on the surprise effect of the stimulus than on the stimulus intensity. Normally reproduced GSRs have common features in their wave shapes, and response amplitudes tend to habituate.

The level of brain arousal affects emotional state and fortuitously this affects skin resistance - a symptom convenient to measure through two electrodes in contact with the skin, across any two points on the body. For example, the two points may be adjacent on one hand or across from one hand to the other. If an EEG is used simultaneously, it will be observed that the increase of brain arousal correspond to the changes of measured skin resistance. The best point at which to measure skin resistance is the thumb and forefinger because this part of the body is most heavily represented neurologically in the evolutionarily advanced thought centres of the brain used to manipulate objects, and therefore closely in touch with will, left brain focused action and right brain contextual holding.

Skin conductance is considered to be a function of the sweat gland activity and the skin's pore size. An individual's baseline skin conductance will vary for many reasons, including gender, diet skin type and situation. Sweat gland activity is controlled in part by the sympathetic nervous system. When a subject is startled or experiences anxiety, there will be a fast increase in the skin's conductance (a period of seconds) due to increased activity in the sweat glands (unless the glands are saturated with sweat)

After a startle, the skin's conductance will decrease naturally due to reabsorption. There is saturation to the effect: when the duct of the sweat gland fills there is no longer a possibility of further increasing skin conductance. Excess sweat pours out of the duct. Sweat gland activity increases the skin's capacity to conduct the current passing through it and changes in the skin conductance reflect changes in the level of arousal in the sympathetic nervous system.

During the winter months in Antarctica, the expeditioners are under stressed condition. This may lead to an increase in the activity of the sweat gland, which in turn may increase the conductance capacity of the skin. Since changes in the skin conductance reflect changes in arousal level in the sympathetic nervous system, it may be assumed that Galvanic skin response indicates one's physiological response to environmental stress. Based on this assumption, it may be considered that the expeditioners to Antarctica experiences changes in the galvanic skin response across summer and winter months there. The purpose of the present study is to examine the pattern of changes in the galvanic skin response across months.

1.3 PSYCHOLOGICAL CHANGES

Despite the harshness of this environment, humans have been living and working in the Antarctic for over hundred years. Since the International Geophysical Year of 1956-1957, There has been a continuous presence on the ice in the form of small, isolated research stations, many of which operate on a year round basis. These stations comprise a collection of "microcultures" where people try to adapt to the isolation, confinement and extreme environmental characteristics. *Third objective of this study was to examine pattern of changes in mental health assessed by GHQ-12 (12 item General Health Questionnaire of Goldberg) across different months in Antarctica in order to understand pattern of psychological adaptation in the Antarctica.*

Extreme environmental conditions have significant effect on people in Antarctica. Those who winter over are blanketed in darkness as the sun sets February, 20 and does not rise again until August, 20. Complete darkness may be related to sleep difficulty. Bhargava, Mukerji and Sachdeva (2000) reported that 80% of crewmembers felt sleep difficulty in June, the mid winter month. Garthwaite (1987) also found that subjects were troubled by sleep disturbances in winter but less so in summer. The occurrence of sleep disturbances in winter months is now a consistent finding in the literature (Natani & Shurley, 1974; Palinkas, Cravalho, et al., 1995). Besides prolonged darkness, ice shelves are important stressors. Presence of ice shelves causes several casualties like skiing injury, frostbites, (Cattermole, 1999), falling in crevices, disorientation and whiteouts etc. Other stressors in Antarctica are very high wind speed (Koppar, 1995), low temperature (Bendiksen, Molvaer, Reitehaug, 1991), blizzards (Joshi, 1995) etc. But modern research stations in Antarctica are well designed to provide protection from the harsh environment. In considering the uncertain weather conditions, people in Maitri get protective gear aid to cover up fully. A single person was not allowed to go out and carrying a radio set was compulsory. Indian station is equipped with an operation theatre, X-ray, laboratory and all kinds of medicines for accidental and cold-weather injuries like frostbite and dental problems. Dr. Vilku, the only woman (51 years) member of the 19th Indian expedition to Antarctica reported very few casualties ─ a) spinal injury due to falling from a tanker which was still 90 km away from the station, b) land crushing by a container door swinging wildly in the strong wind, and c) chemical burns. Dr. Vilku reported that disorientation, white-outs, frostbite and the possibility of falling in crevices were the dangers they were exposed to.

Although these stations are designed to provide protection from the harsh environment, the people who inhabit these stations are subjected to a number of psychosocial stressors namely, isolation, confinement (Palinkas, 2003) and monotony (Taylor, 1969; Natani and Shurley, 1974). Between the months of February and October, the stations are physically isolated from the outside world with darkness and weather conditions preventing travel to and from the continent. Station members are separated from their family and friends back home and consequently experience-varying degrees of emotional deprivation. Isolation reduced gratification of basic needs like sex (Mullin, 1960). Palinkas noted (2003) that personal crisis such as the death of a family member, financial difficulties, or deterioration of marital relations becomes magnified by the separation and distance between the individuals involved. Winter-over crews often experience some level of tension or conflict with external organizations and agencies, usually due to interference with established station routines, delays in the arrival of replacement personnel or supplies, or problems on communication which result from the disruption at times by environmental conditions and the frequent misinterpretation of the meaning of intent of certain messages.

Isolation anxiety becomes high when expeditioners of summer months leave the stations, when people of winter-over months fail to go to the ship at the bay area and when they are left only with restricted telephonic contact with family members. Bhargava et al., (2000) reported that at the Maitri station, communication with subcontinent is limited to a few minutes per month during the 10 months of isolation, and time is spent mainly indoors during the long, dark winter because of the limited outdoor lighting of the station as compared to other stations like New zealand, Australia, etc.).

No one can leave the base during the 6-month winter because planes are unable to fly in -60^{o}C temperature. Sometimes people come to the stations from the stations of different countries. Anxiety occurs when team members go to the other stations to drop up their friends. Dr. Vilku, the only woman member of the 19th Indian expedition to Antarctica reported that when team members went to the Russian station (station near by Maitri) to drop members of the Russian team, they got lost in a blizzard and took hours to reach the station. Disorientation, whiteouts, frostbite and the possibility of falling in crevices were the dangers they were exposed to.

Winter-over crew members reported that the isolation and confinement are more difficult to live with than the extreme environmental conditions. Strange and Youngman, (1971) and Strange and Klein (1974) noted winter-over-syndrome among the crewmembers. This syndrome is characterized by varying degrees of depression; irritability and hostility; insomnia; and cognitive impairment, including difficulty in concentration and memory, absent mindedness, and the occurrence of mild hypnotic states known as "long-eye" or the "Antarctic stare". These symptoms have been observed to increase over time, peaking at mid-winter and then declining during the third quarter of winter-over duty, only to increase again at the end of the winter-over period. These symptoms were first reported by Cook (1900), the polar explorer and the anthropologist who served as physician aboard the Belgica. Since that time, they have been evident in almost every expedition. Most winter-over personnel at both stations experience these symptoms to various degrees. During the 1989 winter season at McMurdo, for instance, 64.1% of the winter-over crew members interviewed reported some problem with sleep over the winter; 62.1% reported feeling depressed, 47.6% reported feeling more irritable than usual; and 51,5% reported difficulty with concentration or memory (Palinkas, 1992). For the most part, these symptoms are relatively mild and do not severely impair performance. However, approximately 5% of winter-over personnel experience symptoms that fulfill DSM criteria (American Psychiatric Association, 1994) for a psychiatric disorder and are severe enough to warrant clinical intervention (Palinkas et al., 1995; Palinkas, Glogower, et al., in press). Although these rates are no higher than what might be experienced in the general population in the United States, they are noteworthy in that these men and women are required to undergo psychiatric screening prior to the austral winter. Those with a history of psychiatric disorders, current symptoms of psychosocial distress, or considered to be at risk for a psychiatric disorder and/or poor performance on the ice are disqualified from winter-over duty. Even among those who fail to meet DSM diagnostic criteria, the ice tends to magnify seemingly trivial events and symptoms, transforming what would be viewed as mundane or unimportant in any other environment into something that is problematic and significant under conditions of isolation and confinement.

Confinement within the station especially during the winter season is stressful (Winisdoeffer and Soulez-Larivière, 1992) because of the constant interaction with the same group of individuals and being in the same environment. Due to confinement within small groups, privacy is disturbed and this also acts as a stress to the expeditioners. Since the work place is within or near the station, people find same environment for work and leisure.

Psychological problem varies across periods (Bell and Garthwaite, 1987, Gunderson and Palinkas, 1991) and across different research stations (Palinkas and Houseal, 2000). Bell and Garthwaite (1987) noted higher scores using General health questionnaire during winter. Gunderson and Palinkas (1991) observed that winter – over syndromes peak during mid winter and then begin to decline but they remain at levels higher than at the beginning of winter.

Experience in the Antarctica provides salutogenic experiences (Palinkas, 1986) – seeking out challenges and obtaining increased self-esteem and self-efficacy. According to Palinkas (1986), extreme environments generate positive forms of adaptation to the characteristics of the physical environment. In certain individuals, particularly those with a low need for social interaction.

In the current study, psychological changes will be studied in terms of GHQ-12 and life events.

1.3.1 GHQ-12

Bell and Garthwaite, (1987), studied the psychological profile of a group of Antarctica explorers using the General Health Questionnaire. In their study particular attention was paid to three men who resigned prematurely, two of whom were diagnosed as psychologically disturbed. It was found that their psychological states, as measured by GHQ scores, showed some marked differences from those of the people who did not resign. They also found that the GHQ scores were generally higher in winter, when there was a greater incidence of sleep disturbance and general illness. As part of the study, the GHQ was also administered to a control group of 21 men living in a conventional urban setting. Their score when compared to that of the people in the Antarctica, who did not resign, showed few differences. The present study follows the psychological profile of a group of logistic personnel and scientists during their stay in Antarctica. The study started in January 1996 and continued till December 1996. The studies main aim is to examine the psychological changes that occur in men during their stay in Antarctica and also to examine the usefulness of the GHQ in an Antarctica setting. The present study also makes an attempt to determine the extent of GHQ-12 profile similarity of the logistic personnel and the scientists in Antarctica expedition.

1.3.2 Life Events

Since the mid-1960s, a field of research has developed that is concerned with the influence of life-changing events on disease, based on the stress-theory approach. The term "life events" describes occurrences that result in major changes in the life of those affected, such as marriage, the death of a close friend, or the loss of a job. To quantify life events, Holmes and Rahe developed the Social Readjustment Rating Scale. This scale comprises a list of events, each of which is weighted with a life change unit. The Social Readjustment Rating Scale is thus far one of the most frequently employed methods used in the assessment of life events. In the current research, attempt was made to assess relative experience of life events in the Antarctica expedition.

The above three objectives would help in understanding high and low stress eliciting months in the Antarctica. In order to understand functional relationship among the environmental, physiological and psychological changes, *fourth objective of the study was to examine association among all the variables under study.*

CHAPTER: 2

METHOD

2.1 Sample

Data were collected from 11 scientists and 8 logistic personnel out of total 25 winter-over expeditioners across twelve months. The scientists were elder (Mean age = 39.70, SD = 7.27) than the logistic personnel (Mean age =35.38, SD = 5.37). 7 of the scientists were married and 3 were unmarried. The mean age of their wives was 37.00 with SD = 6.93 years. Among the logistic personnel, 7 were married and 1 unmarried. The mean age of their wives was 32.33 with SD = 4.18 years. Among the scientists 8 of them were specialized in diverse fields like electronics and communication, drilling, geology, human physiology, meteorology, geomagnetism, mechanical engineering and electronics. One of the scientists was a doctor in I.T.B. Police. All the logistic personnel were educated and could read and write in English. 4 of the logistic personnel were specialized in different fields. The scientists had 5 members in their family on an average (Mean = 4.63, SD = 3.11) and 6 of them came from nuclear families. On the other hand, the logistic personnel had 8 members in their family on an average (Mean = 7.83, SD = 5.98). 4 of the logistic personnel came from joint families and the rest from nuclear families. Among all the members of the group, only 2 of the scientists had previous experience in Antarctica, but for the rest this expedition to Antarctica was for the first time. Both psychological and physiological data were collected on 15^{th} day of each month approximately.

2.2 Maitri Station

Current study was conducted at Maitri station. Based on the experience gained during these expeditions, DRDO developed a full-fledged indigenous station in Antarctica. As such, the second permanent station *Maitri* with all the life support services was developed by DRDO with total indigenous efforts and was constructed by scientists, engineers, and Army or Navy pilots during 1988-89.

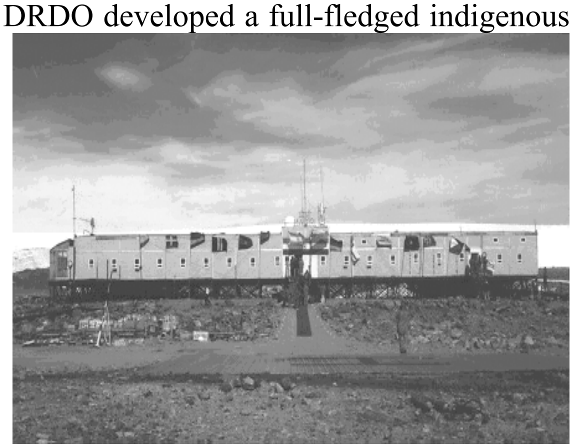

Fig. 2.1 Maitri Station

Since 1989, *Maitri* has been in use for all wintering expeditions. *Maitri* is situated at Schirmacher Hills—an ice-free boulderous terrain. It is located in close vicinity of the shore. The nearby Priyadarshni Lake provides vital water supply to the station throughout the year. For most part of the Antarctic winters, this lake is covered with 2 m of ice. *Maitri* is built on stilts having adjustable telescopic columns as foundation. The structure has been designed to withstand low temperature and wind speeds up to 200 km/h. The foundation on adjustable stilts caters for undulations of the rocky terrain. The station comprises four blocks. The Main Block houses living accommodation, medical facilities, communication control system and laboratory. Block 'A' accommodates workshop, power supply and MI room. Block 'B' houses central heating system, water storage tanks, snowmelt plants, kitchen, dining hall and chemical toilets. Block 'C' provides accommodation for incinerator-type toilets. Adequate storage facility has been provided in the loft above the Main Block. The services available in Maitri station are life support services (power supply and electrical system, central heating system, water supply system, solid and liquid waste disposal system, fire protection system), communication system for communication between Antarctica and India, communication between different stations in Antarctica and with the ship during voyage, transportation system for transport of ration, fuel and other materials by ship to the Indian bay in Antarctica and from there by helicopters to the station, protected vegetable production system involving green house, hydroponics and photo period regulation to produce different vegetables like cucumber, tomato, chilli, capsicum, brinjal, spinach, fenugreek, coriander, lettuce, celery, radish, mint, onion, and garlic in Antarctica. Sufficient care is taken to ensure that foods remain wholesome and nutritious for more than 15 months, processed and packed in such a way that persons unaccustomed to the art of culinary can prepare tasty meals by simple warming and heating. The range is kept wide enough to design various menus to avoid monotony. Thus, ready-to-eat and ready-to-cook shelf-stable products of Indian dietary are made available by DRDO for Antarctic expeditions. Antarctic clothing based on multi layer principle protects men from extreme cold conditions and glacier regions.

2.3 The Data Set

The total data set included data set of atmospheric, physiological and psychological variables. These data were collected in 12th Antarctica expedition. Description of the data sets is given below.

2.3.1. Atmospheric Data Set

Five atmospheric variables were considered in this study. They were Visibility, Direction of Wind movement and Wind Speed, Temperature, Sea-level Pressure and Station Pressure. Visibility and wind directions were categorical in nature. On the other hand metric data system was followed in making data set of the remaining three variables. All atmospheric data were collected at eight different periods 12,3,6,9 A.M and 12,3,6,9 P.M across three specific dates in each month.

2.3.2 Physiological Data Set

Four physiological variables were in the data set. They were Weight, Basal metabolic rate, Total body water, Galvanic skin response. Weight included four parameters as Total body weight, percentage body fat, fat body weight and lean body weight. The data were collected from 19 (11 scientists and 8 logistic personnel) individuals across twelve months in Antarctica out of total 25 winter over expeditioners.

2.3.3 Psychological Data Set

Psychological data set included 18 (sample) X 12 (GHQ –12 item weightage) matrix and 18(sample) X 21 (items of life events) matrix.

2.4 Instruments

Few meteorological apparatus like Low Level Slow Rising Radiosonde, Precision Aneroid barometer, Weekly barograph, Aneroid barometer, DR wind instrument for wind direction and speed, Hand held cup anemometer were used to determine different atmospheric parameters.

Physical weighing balance and Computerized data logger were used to assess different physiological parameters.

The 12 item General health Questionnaire and a rating scale with 20 items were used to study changes in mental health and stress experience of expeditioners across months. Life event was assessed by a scale of 21 items.

CHAPTER: 3

RESULTS OF ATMOSPHERIC CHANGES

3.1 VISIBILITY

Month wise Variation

Table 3.1.1 represents frequency of month and period wise visibility across different ranges. Table 3.1.2 shows that visibility level varies with month. It was lower in the winter season than the summer season in Antarctica. In Antarctica, summer season starts from November and continues up to middle of March. Possibly due to this reason visibility level was within the range of 2km to 4 km. in November (67%) and December (50%). On the other hand it was mostly more than 4 km in February (63%) and March (50%). In January (42%), visibility level was mostly within the range of 2km to 10km. This observation is consistent with earlier study conducted by Joshi (1995).

Visibility level was less than 1 km from April to October. It was very low (less than 50m) particularly in July (33%) and September (33%).

Month and Period wise Visibility

Visibility level changes not only with month but also with the period. In January, from 12 p.m. to 9 p.m. and 12 p.m. to 9 a.m., visibility level was more at the range of 2 to 4km and 4 to 10 km respectively (Table 3.1.3). In February and March visibility level was less than 10 km between 12 a.m. to 3 a.m. and between 6 p.m. to 9 p.m.

Again in May the occurrence in visibility level in the range of 1km to 2km started rising gradually from 3 p.m. and reached a maximum at 9 p.m. and at 12 night. In July visibility level of less than 50m remained constant from 12 night to 9 p.m. whereas visibility level was highest at 200m to500m. In November visibility in the range of 4km to10km started rising from 6 a.m. and remained high till 9 p.m.

Duration of visibility

Table 3.1.4 shows that all categories of visibility were not found across all months. It lasted for 24 and 18 hours in December and January respectively at the range of 2km to 4km. On the other hand, visibility lasted in the range of 200m to 500m for 18 hours in July and August and for 15 hours in May.

Table 3.1.1.
Month and Period wise visibility pattern across Ranges

		Periods									
Month	Visibility Distance	0	3	6	9	12	15	18	21	Total	%
Jan	.5km-1km	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	1	4.16
	1km-2km	1	1	Nil	Nil	Nil	Nil	Nil	1	3	12.5
	2km-4km	Nil	Nil	2	1	2	2	1	2	10	41.66
	4km-10km	2	2	1	2	1	1	1	0	10	41.66
Feb	.5km-1km	1	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	4.16
	1km-2km	2	Nil	Nil	Nil	Nil	Nil	Nil	2	4	16.66

		Periods									
	2km-4km	Nil	2	Nil	Nil	Nil	Nil	1	1	4	16.66
	4km-10km	Nil	1	3	3	3	3	2	Nil	15	62.5
Mar	.5km-1km	2	Nil	Nil	Nil	Nil	Nil	Nil	2	4	16.66
	1km-2km	1	2	Nil	Nil	Nil	Nil	Nil	1	4	16.66
	2km-4km	Nil	1	Nil	Nil	Nil	Nil	3	0	4	16.66
	4km-10km	Nil	Nil	3	3	3	3	Nil	0	12	50
Apr	< 50m	Nil	Nil	Nil	1	1	1	Nil	Nil	3	12.5
	50m-200m	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	1	4.16
	200m-500m	2	2	Nil	Nil	Nil	Nil	2	1	7	29.16
	.5km-1km	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	1	4.16
	1km-2km	1	Nil	1	Nil	1	Nil	Nil	2	5	20.83
	2km-4km	Nil	1	1	1	Nil	Nil	1	Nil	4	16.66
	4km-10km	Nil	Nil	Nil	1	1	1	Nil	Nil	3	12.5
May	< 50m	Nil	1	1	Nil	Nil	Nil	Nil	Nil	2	8.3
	50m-200m	Nil	1	1	Nil	Nil	Nil	Nil	Nil	2	8.3
	200m-500m	3	1	1	2	Nil	2	2	3	14	58.3
	.5km-1km	Nil	Nil	Nil	Nil	2	Nil	Nil	Nil	2	8.3
	1km-2km	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	1	4.16
	2km-4km	Nil	Nil	Nil	1	1	Nil	1	Nil	3	12.5
June	50m-200m	Nil	Nil	3	Nil	Nil	3	Nil	Nil	6	25
	200m-500m	1	3	Nil	1	Nil	Nil	1	1	7	29.16
	.5km-1km	2	Nil	Nil	2	Nil	Nil	2	2	8	33.3
	1km-2km	Nil	Nil	Nil	Nil	3	Nil	Nil	Nil	3	12.5
July	< 50m	1	1	1	1	1	1	1	1	8	33.3
	200m-500m	1	2	2	Nil	Nil	1	2	2	10	41.66
	.5km-1km	1	Nil	Nil	1	Nil	1	Nil	Nil	3	12.5
	1km-2km	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	1	4.16
	2km-4km	Nil	Nil	Nil	Nil	2	Nil	Nil	Nil	2	8.3
Aug	200m-500m	3	3	Nil	Nil	Nil	Nil	3	3	12	50
	.5km-1km	Nil	Nil	3	Nil	Nil	Nil	Nil	Nil	3	12.5
	2km-4km	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	1	4.16
	4km-10km	Nil	Nil	Nil	3	Nil	2	Nil	Nil	5	20.83
	10km-15km	Nil	Nil	Nil	Nil	3	Nil	Nil	Nil	3	12.5
Sep	< 50m	3	3	Nil	Nil	Nil	Nil	Nil	2	8	33.3
	200m-500m	Nil	Nil	Nil	Nil	Nil	Nil	1	1	2	8.3
	.5km-1km	Nil	Nil	1	1	1	1	Nil	Nil	4	16.6
	1km-2km	Nil	Nil	2	1	Nil	Nil	1	Nil	4	16.6
	2km-4km	Nil	Nil	Nil	1	1	1	1	Nil	4	16.6
	4km-10km	Nil	Nil	Nil	Nil	1	1	Nil	Nil	2	8.3
Oct	< 50m	2	Nil	Nil	Nil	1	Nil	Nil	Nil	3	12.5
	50m-200m	Nil	Nil	Nil	1	Nil	Nil	Nil	2	3	12.5
	.5km-1km	1	Nil	Nil	Nil	Nil	1	Nil	Nil	2	8.3
	1km-2km	Nil	1	Nil	Nil	Nil	Nil	1	1	3	12.5
	2km-4km	Nil	Nil	1	1	Nil	Nil	Nil	Nil	2	8.3
	4km-10km	Nil	2	2	1	1	1	1	Nil	8	33.3

					Periods						
	10km-15km	Nil	Nil	Nil	Nil	1	1	1	Nil	3	12.5
Nov	2km-4km	1	1	Nil	Nil	Nil	Nil	Nil	Nil	2	8.3
	4km-10km	2	Nil	2	2	2	3	2	3	16	66.6
	10km-15km	Nil	2	1	1	1	Nil	1	Nil	6	25
Dec	50m-200m	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	1	4.16
	.5km-1km	1	1	Nil	Nil	Nil	Nil	Nil	1	3	12.5
	1km-2km	Nil	Nil	Nil	1	Nil	Nil	1	1	3	12.5
	2km-4km	Nil	Nil	2	1	3	3	2	1	12	50
	4km-10km	1	1	Nil	1	Nil	Nil	Nil	Nil	3	12.5
	10km-15km	1	1	Nil	Nil	Nil	Nil	Nil	Nil	2	8.3

Table 3.1.2
Distribution of month wise Visibility (in proportion)

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
< 50m				0.13	0.08		0.33		0.333	0.13		
50m-200m				0.04	0.08	0.25				0.13		0.04
200m-500m				0.29	0.58	0.29	0.42	0.5	0.083			
.5km-1km	0.04	0.04	0.17	0.04	0.08	0.33	0.13		0.166	0.08		0.13
1km-2km	0.13	0.17	0.17	0.21	0.04	0.13	0.04	0.13	0.166	0.13		0.13
2km-4km	0.42	0.17	0.17	0.17	0.13		0.08	0.04	0.166	0.08	0.08	0.5
4km-10km	0.42	0.63	0.50	0.13				0.21	0.083	0.33	0.67	0.13
10-15 km								0.13		0.13	0.25	0.08

Table 3.1.3
Duration of Visibility (at least at a stretch of 3 hours)

Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
< 50m	Nil	Nil	Nil	6	3	Nil	21	Nil	9	Nil	Nil	Nil
50m-200m	Nil	Nil	Nil	Nil	3	Nil	Nil	Nil	Nil	Nil	Nil	Nil
200m-500m	Nil	Nil	Nil	9	15	6	18	18	3	Nil	Nil	Nil
0.5km-1km	Nil	Nil	Nil	Nil	Nil	6	Nil	Nil	9	Nil	Nil	3
1km-2km	3	Nil	3	Nil	Nil	Nil	Nil	Nil	3	3	Nil	3
2km-4km	18	Nil	Nil	3	3	Nil	Nil	Nil	3	3	3	24
4km-10km	21	36	27	6	Nil	Nil	Nil	Nil	3	18	30	3
10km-15km	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	6	9	3

Classification

Based on scatter diagram (Fig.3.1.1), all the months can be clustered into three broad groups as high, moderate and low visibility months. High visibility months are January, February, March and November. In these months, visibility level was high within the range of 4 to 10 kilometers. Low visibility months were June, July, August and September. In these months, visibility level was high within the range of less than 1 kilometer. In the moderate visibility months (April, May, October and December), visibility level

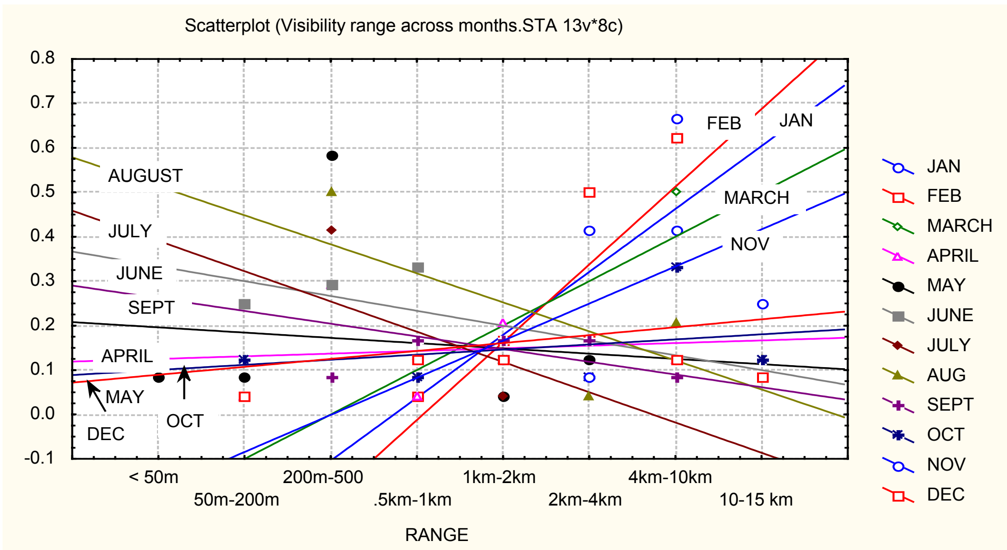

Figure 3.1.1
Scatter Diagram of Visibility Data

fluctuated both in higher (more than 1 kilometer) and lower range (less than 1 kilometer) of visibility. Results noted constancy of visibility level for prolonged period in few months as July and November.

3.2 DIRECTION OF WIND MOVEMENT

Month wise variation

Since, wind blow from each direction across each period was not available, only the frequencies of wind direction were computed irrespective of periods. Table 3.2.1 and Figure 3.2.1 represent frequency distribution of wind direction across months. It was noted that wind blew from East-Southeast (n = 74, 25.69%) and southeast (n = 83, 28.82%) direction in most of the times. This is in consistent with earlier study conducted by Kopper (1995). Kopper noted that the prevailing direction is Southeast closely followed by East-Southeast. On 80% of the occasions, wind blew from the Southeast quadrant. All other directions put together account for only 11%. Other directions from which wind blew relatively more were north (n = 28, 9.72%) and south (n = 35, 12.15%). In September (n-18, 75%), November (n=12, 50%) and May (n=11, 45.83%), wind blew mainly from east-southeast. On the other hand wind blew more from southeast in December (n=20, 83.3%) and July (n=12, 50%). In August wind blew mostly from the north direction (n=8), and south direction (n=7) and in January wind blew mostly from the south direction (n=7). As revealed from Table 3.2.1, wind never blew from West-northwest and Northwest directions.

Figure 3.2.1 shows that data for most of the months were available in case of east-southeast and southeast. Therefore, attempt was made to find out month wise variation of wind blow for these two directions. The wind direction frequencies significantly (Chi-square (11) = 64.17, P<0.00001) varied across months. Wind blew from southeast direction was high in December (n=20, 83.3%), June (n=14, 58.33%), July (n=12, 50%), March (n=7,29.17%), and January (n=3, 12.5%) than the east-southeast direction. On the other hand, wind blow from east-southeast direction was high in September (n= 18, 75%), November (n=12,50%), April (n=9, 37.5%) and May (n=11, 45.83%). Here, denominator of the equation was 24 (3 days for each month X 8 periods).

Summer and Winter wise variation

Table 3.2.1 shows that wind movement is erratic. Therefore wind direction data of 12 months were grouped into two seasons: summer (November to February) and winter (March to October). Table 3.2.2 shows the frequency distribution of wind direction in summer and winter seasons. It was noted that wind direction varied between two seasons significantly (Chi-square (13) = 29.77, P<0.005). In summer season, wind blow was high from south-southwest (n=7, 2.43%) and southwest (n=6, 2.08%) and northeast (n=3, 1.04%) than winter season. On the other hand, wind blow was high from east-southeast (n=58, 20.14%), east (n=23, 7.99%), southeast (n=58, 18.40%), north (n=19, 6.60%), south southeast (n=7, 2.43%) and south (n=20, 6.94%) direction in winter season than the summer.

Table 3.2.1
Frequency distribution of wind direction
(12 months X 8 periods X 3 days =288 observations)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	%
N		6	5				6	8			3		28	9.72
NNE		1										1	2	0.69
NE	2								1	1		1	5	1.74
ENE				1									1	.35
E	2			12	2		1		3	5		1	26	9.03
ESE		3	1	9	11	6	5		18	8	12	1	74	25.69
SE	3	3	7	2	5	14	12	5		8	4	20	83	28.82
SSE		1				1		4	2		1		9	3.13
S	9	3	4		6	3		7			3		35	12.15
SSW	4	3	3										10	3.47
SW	3	3	3										9	3.13
WSW	1		1										2	0.69
W										1	1		2	0.69
WNW													0	0
NW													0	0
NNW		1								1			2	.69

Note: N = north, NNE = north north east, NE = north east, ENE = east north east, E = east, ESE = east south east, SE = south east, SSE = south south east, S = south, SSW = south south west, SW = south west, WSW = west south west, W = west, WNW = west north west, NW = north west, NNW = north north west.

Table 3.2.2
Frequency distribution of wind in summer and winter

	Summer			Winter	Total	
	f	%	F	%	F	%
N	9	3.13	19	6.6	28	9.72
NNE	2.00	0.69	0.00	0.00	2.00	0.69
NE	3.00	1.04	2.00	0.69	5.00	1.74
ENE	0.00	0.00	1.00	0.35	1.00	0.35
E	3.00	1.04	23.00	7.99	26.00	9.03
ESE	16.00	5.56	58.00	20.14	74.00	25.69
SE	30.00	10.42	53.00	18.40	83.00	28.82
SSE	2.00	0.69	7.00	2.43	9.00	3.13
S	15.00	5.21	20.00	6.94	35.00	12.15
SSW	7.00	2.43	3.00	1.04	10.00	3.47
SW	6.00	2.08	3.00	1.04	9.00	3.13
WSW	1.00	0.35	1.00	0.35	2.00	0.69
W	1.00	0.35	1.00	0.35	2.00	0.69
NNW	1.00	0.35	1.00	0.35	2.00	0.69
Total	96.00	33.33	192.00	66.67	288.00	100.00

Note: N = north, NNE = north north east, NE = north east, ENE = east north east, E = east, ESE = east south east, SE = south east, SSE = south south east, S = south, SSW = south south west, SW = south west, WSW = west south west, W = west, WNW = west north west, NW = north west, NNW = north north west.

Table 3.2.3
Distribution of wind movement from East south east and South east direction across twelve months

Months	East South East	South East
January	0	3
February	3	3
March	1	7
April	9	2
May	11	5
June	6	14
July	5	12
August	0	5
September	18	0
October	8	8
November	12	4
December	1	20

3.3 WIND SPEED

Month wise variation

Table 3.3.1 shows that wind speed varied across months significantly ($F(11,176)= 8.94; p<.0000$). It started rising from January (Mean = 9.59, SD = 3.65) and reached the maximum in April (Mean = 30.96, SD = 10.54). It was below the grand mean level (M=20.89) from July (Mean = 19.26, SD = 5.43) to September (Mean = 18.59, SD = 4.10) falling abruptly in August (Mean = 11.37, SD = 4.59). It fell below the grand mean level again in November (Mean = 18.07, SD = 4.71).

Table 3.3.1
Wind speed across months (in knots)

Month	Mean	SD
January	9.59	3.65
February	10.30	4.35
March	15.78	5.80
April	30.96	10.54
May	24.96	8.44
June	22.22	6.95
July	19.26	5.43
August	11.37	4.59
September	18.59	4.10
October	28.52	7.62
November	18.07	4.71
December	21.81	5.11

Period wise variation

Average wind speed across the time period (irrespective of months) ranged from 19.17 knots (6 P.M) to 21.81 knots (3 A.M). But this period wise wind speed difference did not vary significantly ($F(7,77) = 0.5991$, $p<0.7547$). No significant difference ($F(7,77) = 0.5991; p<0.7547$) in wind speed was noted across 8 periods.

Table 3.3.2
Wind Speed across 8 Periods (in knots)

Time	n12	n3	n6	n9	d12	d3	D6	d9
January	10.67	11.00	11.67	13.00	10.67	9.33	7.00	12.00
February	6.33	10.00	12.67	12.00	16.33	8.00	11.00	14.33
March	20.67	20.00	16.67	15.33	12.67	22.33	13.33	18.00
April	37.67	36.00	36.00	32.00	35.33	37.33	31.67	28.67
May	31.33	32.67	25.00	30.67	29.67	22.00	22.33	26.00
June	26.67	28.00	27.00	26.67	24.67	22.00	21.33	17.67
July	19.33	17.67	18.67	19.33	24.00	26.33	18.67	22.33
August	4.00	6.33	11.67	13.33	15.33	18.00	15.00	10.67
September	18.67	18.33	23.00	22.00	17.67	17.33	21.00	20.33

Time	n12	n3	n6	n9	d12	d3	D6	d9
October	34.00	36.33	32.67	31.00	27.33	27.33	27.67	30.33
November	24.00	25.33	20.00	20.33	14.67	17.00	14.33	16.00
December	20.00	20.00	18.33	21.00	23.67	25.67	26.67	29.00
Mean	21.11	21.81	21.11	21.39	21.00	21.06	19.17	20.44
SD	10.51	10.06	7.94	7.29	7.58	8.00	7.34	6.81

Table 3.3.3
One-way ANOVA with Repeated Measurements of Wind Speed

	df Effect	MS Effect	df Error	MS Error	F	p-level
Time	7.00	22.61	16.00	162.32	0.14	0.99
Month	11.00	1385.06	176.00	154.91	8.94	0.00
Time X Month	77.00	37.25	176.00	154.91	0.24	1.00

Comparison with earlier study

Findings of the current study may be compared with earlier study of Kopper (1995) in 1992. Table 3.3.4 shows that Wind speed variation between two studies was high in April (Squared difference = 194.88) and October (Squared difference = 182.79) and it was very low in August (Squared difference = 7.45). Wind speed was relatively high across 8 months (April – July, September – December) in 1996 than in 1992. In 1992, May was found to be the windiest month (21 knots) and wind speed was minimum in September, November and December (Mean = 13 knots). On the other hand, in 1996, April was the windiest month (30.96 knots) and wind speed was minimum in January (9.59 knots). This variation suggests erratic nature of wind speed

Table 3.3.4
Comparison between wind speed across 12 months in 1992 and 1996 (in knots)

Months	1992	1996	Difference	Squared Difference
January	14.00	9.59	4.41	19.45
February	14.00	10.30	3.70	13.69
March	20.00	15.78	4.22	17.81
April	17.00	30.96	-13.96	194.88
May	21.00	24.96	-3.96	15.68
June	18.00	22.22	-4.22	17.81
July	15.00	19.26	-4.26	18.15
August	14.00	11.37	2.73	7.45
September	13.00	18.59	-5.59	31.25
October	15.00	28.52	-13.52	182.79
November	13.00	18.07	-5.07	25.70
December	13.00	21.81	-8.81	77.62

3.4 TEMPERATURE

Mean and Standard deviations are given in Table 3.4.1. Mean temperature varied across months significantly ($F(11, 176) = 93.95$; $p<0.00$). In Antarctica, summer starts from November and continues upto February. Sun light is available in these 4 months. Therefore due to solar radiation, temperature varied from -0.67^{0}C in December to –4.39^{0}C in February in summer season. On the other hand temperature varied from -0.8.94^{0}C in April to – 20.60^{0}C in August in the winter season. No significant main effect of period ($F(7, 16) = 0.98$, NS) and interaction effect of period and months ($F(77, 176) = 0.69$, NS) on variation of temperature were noted suggesting uniform temperature across the periods.

Comparison with earlier study

Findings of the current study may be compared with the previous study of Koppar (1995). Table 3.3.4 shows that temperature in 1996 started decreasing steadily from December (-0.67^{o}C) and reached a minimum in August (-20.60^{o}C) after which there was a sharp increase in temperature. This observation was closely related to that of 1992. In 1992 temperature started falling from January (1.3^{o}C) and continued till August (-18.9^{o}C) and thereafter there was an abrupt rise in temperature. These two studies were found to be significantly correlated ($r=0.82$; $p=0.0037$).

Table 3.4.1
Temperature across months (in degree Celsius)

Months	Mean	SD
January	-2.91	1.80
February	-4.39	2.06
March	-9.41	2.06
April	-8.94	4.95
May	-14.61	4.69
June	-10.75	2.05
July	-16.32	3.50
August	-20.60	4.12
September	-8.76	1.06
October	-9.33	2.34
November	-3.53	1.79
December	-0.67	2.42

Table 3.4.2
Temperature across 8 Periods (in degree Celsius)

Time	12 A.M.	3 A.M.	6 A.M.	9 A.M.	12 P.M.	3 P.M.	6 P.M.	9 P.M.
January	-4.70	-5.27	-4.10	-1.60	-1.57	-0.97	-2.10	-3.00
February	-5.90	-5.90	-5.27	-2.83	-1.77	-3.23	-4.57	-5.67
March	-9.77	-10.40	-10.67	-8.93	-7.50	-7.80	-9.07	-11.17
April	-2.90	-10.57	-9.50	-9.50	-8.67	-10.30	-10.50	-9.60
May	-16.53	-15.90	-16.17	-15.83	-15.33	-15.27	-10.67	-11.17

June	-10.20	-10.17	-10.10	-10.10	-10.63	-10.97	-11.60	-12.23
Time	12 A.M.	3 A.M.	6 A.M.	9 A.M.	12 P.M.	3 P.M.	6 P.M.	9 P.M.
July	-15.70	-16.27	-16.17	-15.53	-16.07	-15.80	-17.30	-17.69
August	-23.33	-23.10	-22.90	-20.43	-17.83	-18.90	-18.73	-19.57
September	-8.63	-8.83	-9.03	-9.07	-8.57	-8.53	-8.43	-9.00
October	-10.57	-9.77	-9.00	-8.40	-8.33	-8.43	-9.70	-10.47
November	-4.73	-4.63	-2.60	-2.27	-2.07	-2.90	-3.90	-5.10
December	-2.13	-2.37	-1.80	-0.13	0.80	0.57	0.33	-0.67
Mean	-9.59	-10.26	-9.77	-8.72	-8.13	-8.54	-8.85	-9.61
Minimum	-23.33	-23.10	-22.90	-20.43	-17.83	-18.90	-18.73	-19.57
Maximum	-2.13	-2.37	-1.80	-0.13	0.80	0.57	0.33	-0.67

Table 3.4.3
Temperature profile across 12 months in 1992 and 1996 (in degree Celsius)

Month	Mean	
	1992	1996
January	1.3	-2.91
February	-1.8	-4.39
March	-5.9	-9.41
April	-10.7	-8.94
May	-10.9	-14.61
June	-12.7	-10.75
July	-16.0	-16.32
August	-18.9	-20.60
September	-18.3	-8.76
October	-12.8	-9.33
November	-6.0	-3.53
December	-0.8	-0.67

Classification

Single linkage cluster analysis using Euclidean distance matrix reveals two broad clusters of months. For cluster analysis, total data set (24 X 12 matrix) was used. Here 24 rows meant 3 observations for each of the 8 intervals. Dendrogram (Figure 3.4.1) revealed two broad clusters. One cluster included two sub clusters – months with high (January, November, February and December) and moderate temperature (March, October, September, June and April). Other cluster consisted months for lowest temperature (May, July and August) only.

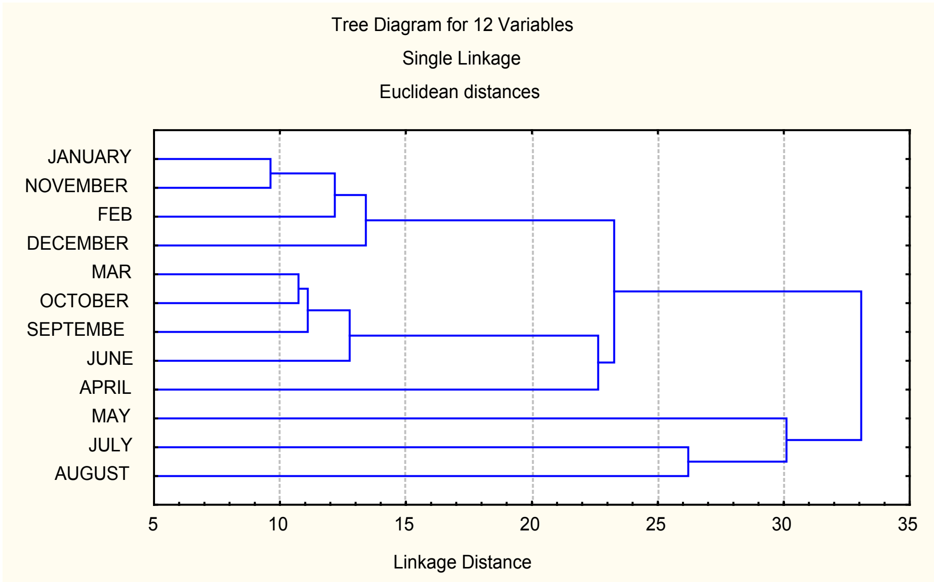

Fig.: 3.4.1
Dendrogram to classify the months in terms of temperature

Table 3.4.4
Euclidean Matrix of temperature level across twelve months

Months	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1 JANUARY	-2.91	1.80	0.00											
2 FEB	-4.39	2.06	12.18	0.00										
3 MAR	-9.41	2.06	33.73	25.87	0.00									
4 APRIL	-8.94	4.95	40.21	36.00	24.70	0.00								
5 MAY	-14.61	4.69	60.90	57.26	37.38	44.67	0.00							
6 JUNE	-10.75	2.05	41.33	33.22	12.81	26.04	36.91	0.00						
7 JULY	-16.32	3.50	68.36	61.42	36.31	43.33	30.11	33.08	0.00					
8 AUGUST	-20.60	4.12	88.54	81.85	57.37	64.28	39.55	53.95	26.21	0.00				
9 SEPTEMBE	-8.76	1.06	30.68	23.27	11.10	25.11	38.55	12.77	41.96	61.87	0.00			
10 OCTOBER	-9.33	2.34	33.68	28.31	10.74	22.63	36.05	15.87	36.02	57.58	15.07	0.00		
11 NOVEMBER	-3.53	1.79	9.63	12.71	30.76	35.13	59.80	37.30	64.58	85.62	28.00	29.35	0.00	
12 DECEMBER	-0.67	2.42	13.41	23.51	45.02	48.96	70.48	52.83	78.87	99.58	42.54	43.90	18.23	0.00

Table 3.4.5
Mean and Standard deviation of three clusters of months

	Mean	SD	Months
Cluster 1	-2.88	2.43	January, February, November and December.
Cluster 2	-9.44	2.85	March, October, September, June and April.
Cluster 3	-14.55	4.50	May, July and August.

3.5 SEA LEVEL PRESSURE

Month wise variation

Table 3.5.1 shows pressure at sea-level varied across months significantly ($F(11, 176)=47.68$; $p<0.00$). Mean sea-level pressure varied between 973.02 mb (in April) and 1002.31 mb (in November). Sea-level pressure started falling gradually from January (Mean=991.18 mb; SD=1.08) and reached a minimum level in April (Mean=973.02 mb; SD=8.30). The pressure level thereafter followed an alternately rising and falling pattern before abruptly falling in October (Mean=976.99 mb; SD=9.69) and then reaching a maximum in November (Mean=1002.31 mb; SD=7.57). The seasonal variation in pressure was not very pronounced.

Period wise variation

Data were collected at 8 intervals. Table3.5.2 shows sea-level pressure across time and across month. Mean sea-level pressure across the time period (irrespective of months) ranged from 987.84 mb at 3 P.M to 990.52 mb at 12 A.M. However, this period wise difference did not vary significantly ($F(7, 16)=0.182$ $p<0.985$).

Month and period wise interaction

Table 3.5.3 shows no significant interaction between month and periods in sea-level pressure ($F(77, 176)= 0.150$; $p<1.00$).

Comparison with earlier study

The present study may be compared with the earlier study of Koppar (1995) conducted in 1992. In his study Koppar (1995) observed that mean sea-level pressure varied between 978.7 hectopascal (in August) and 994.9 hPa (in June). Seasonal variation in pressure was not clear but the trend of alternately rising and falling with humps in summer and winter and sinks in autumn and spring, was discernible. In the present study however, the mean sea-level pressure varied between 973.02 mb (in April) and 1002.31 mb (in November). The pressure level thereafter followed an alternately rising and falling pattern before abruptly falling in October (Mean = 976.99 mb; SD = 9.69) and then reaching a maximum in November (Mean = 1002.31 mb; SD = 7.57). The seasonal variation in pressure was not very pronounced. Table 3.5.4 shows the sea-level pressure profile between 1992 and 1996.

Table 3.5.1
Sea Level Pressure across months (in millibar)

Month	Mean	Minimum	Maximum	SD
January	991.18	989.60	993.00	1.08
February	990.90	981.30	996.00	3.93
March	985.31	979.90	991.20	4.02
April	973.02	951.50	982.10	8.30
May	979.12	972.60	991.50	4.50
June	994.26	988.10	998.60	3.93
July	992.48	975.80	1001.20	7.81
August	991.14	979.50	1000.20	7.02

Month	Mean	Minimum	Maximum	SD
September	997.80	995.60	999.20	1.06
October	976.99	963.30	989.30	9.69
November	1002.31	990.90	1014.00	7.57
December	996.90	985.80	1002.40	4.65

Table 3.5.2
Sea-Level Pressure across 8 periods (in millibar)

Months	12 A.M.	3 A.M.	6 A.M.	9 A.M.	12 P.M.	3 P.M.	6 P.M.	9 P.M.
January	991.30	991.43	991.50	991.37	991.13	990.63	990.90	991.17
February	993.87	993.30	992.43	990.97	989.80	989.23	988.60	988.97
March	985.63	985.30	984.70	985.50	988.53	984.40	984.40	984.00
April	978.17	975.63	973.60	972.27	969.23	970.00	971.63	973.60
May	980.87	978.33	980.00	979.43	978.33	977.63	981.63	976.70
June	993.90	993.77	993.67	994.63	991.43	995.07	995.77	995.87
July	993.90	993.00	993.20	993.10	992.63	991.97	990.83	991.20
August	994.10	993.23	991.70	990.17	989.03	989.63	990.43	990.83
September	997.57	997.53	997.77	998.10	998.27	998.00	997.73	997.43
October	979.23	976.70	977.90	977.57	976.80	976.47	975.87	975.37
November	1002.80	999.17	1002.40	1002.57	1002.87	1002.63	1002.73	1003.30
December	998.23	998.33	998.33	998.07	997.03	995.60	994.90	994.70
Mean	990.80	989.64	989.77	989.48	988.76	988.44	988.79	988.59
Minimum	978.17	975.63	973.60	972.27	969.23	970.00	971.63	973.60
Maximum	1002.80	999.17	1002.40	1002.57	1002.87	1002.63	1002.73	1003.30
SD	8.00	8.51	8.85	9.15	9.63	9.65	9.06	9.37

Table 3.5.3
One-way ANOVA with Repeated Measurements of Sea-Level Pressure

	df Effect	MS Effect	Df Error	MS Error	F	p-level
Time	7	22.65	16	124.09	0.18	0.99
Month	11	1919.57	176	40.26	47.68	0.00
Time X Month	77	6.08	176	40.26	0.15	1.00

Table 3.5.4
Sea-Level Pressure profile across 12 months in 1992 and 1996

Month	Mean	
	1992	1996
January	989.4	991.18
February	991.1	990.90
March	984.3	985.31
April	984.6	973.02
May	990.3	979.12
June	994.9	994.26
July	982.3	992.48
August	978.7	991.14
September	985.0	997.80
October	986.5	976.99
November	979.5	1002.31
December	984.2	996.90

3.6 STATION PRESSURE

Month wise variation

Table 3.6.1 shows that station pressure varied across months significantly ($F(11,176)=40.60$; $P<0.00$). Mean station pressure varied between 958.15 mb in April and 987.90 mb in November. Station pressure started falling from January (Mean = 976.64 mb; SD = 1.03) and dropped to a minimum level in April (Mean = 958.15 mb; SD = 8.30). The pressure level thereafter followed an alternately rising and falling pattern before abruptly falling in October (Mean = 962.47 mb; SD = 9.68) as in the case of pressure at the sea-level. The pressure reached a peak level finally in November (Mean = 987.90 mb; SD = 7.62).

Period wise variation

The station pressure data were collected at 8 time points. Table 3.6.2 shows station pressure across time and across months. Mean station pressure across the time period (irrespective of months) varied between 973.57 mb at 3 P.M. and 975.94 mb at 12 A.M. But this period wise variation in station pressure was not significant ($F(7, 16)=0.17$; $p<0.99$). Station pressure started decreasing steadily from 12 A.M. and reached a minimum level at 3 P.M. after which there was a little rise in pressure at 6 P.M. (Mean = 975.13 mb; SD = 8.50) before falling again at 9 P.M. (Mean = 973.91mb; SD = 8.91).

Month and Period wise interaction

Table 3.6.3 shows that the interaction between months and periods in station pressure was not significant ($F(77, 176)=0.10$; $p<1.00$).

Table 3.6.1
Station Pressure across months (in millibar)

Month	Mean	Minimum	Maximum	SD
January	976.64	975.20	978.30	1.03
February	976.27	966.60	981.10	3.82
March	969.80	964.40	976.50	4.11
April	958.15	937.40	967.10	8.30
May	968.16	957.80	979.60	7.95
June	979.61	974.00	983.30	3.63
July	976.87	961.00	985.50	7.65
August	975.50	964.50	984.50	6.77
September	982.78	980.60	984.10	1.03
October	962.47	948.70	974.30	9.68
November	987.90	976.50	998.10	7.62
December	982.38	971.50	987.70	4.52

Table 3.6.2
Station Pressure across periods (in millibar)

Months	12 A.M.	3 A.M.	6 A.M.	9 A.M.	12 P.M.	3 P.M.	6 P.M.	9 P.M.
January	976.67	976.80	976.90	976.80	976.57	976.20	976.47	976.70
February	979.03	978.53	977.70	976.37	975.33	974.70	974.20	974.27
March	970.70	970.33	969.73	970.67	970.43	968.10	969.47	969.00
April	962.63	960.90	958.93	957.57	954.63	953.73	957.90	958.90
May	968.83	967.70	968.63	968.63	967.93	967.20	971.00	965.33
June	978.90	978.73	978.63	979.60	979.70	979.97	980.63	980.73
July	977.67	977.70	977.87	977.77	977.30	974.97	975.90	975.77
August	978.30	977.47	975.80	974.63	973.63	974.17	974.97	975.00
September	982.53	982.53	982.77	983.10	983.30	983.00	982.67	982.37
October	964.43	963.60	963.20	962.90	962.17	961.77	961.13	960.57
November	987.93	987.63	987.67	987.90	988.10	987.90	987.90	988.13
December	983.60	983.70	983.70	983.50	982.57	981.13	980.63	980.20
Mean	975.94	975.47	975.13	974.95	974.31	973.57	974.41	973.91
Minimum	962.63	960.90	958.93	957.57	954.63	953.73	957.90	958.90
Maximum	987.93	987.63	987.67	987.90	988.10	987.90	987.90	988.13
SD	7.75	8.18	8.50	8.78	9.41	9.56	8.63	8.91

Table 3.6.3
One-way ANOVA with Repeated Measurements of Station Pressure

	df Effect	MS Effect	df Error	MS Error	F	p-level
Time	7	23.17	16	135.01	0.17	0.99
Month	11	1798.53	176	44.30	40.60	0.00
Time X Month	77	4.61	176	44.30	0.10	1.00

CHAPTER: 4

RESULTS OF PHYSIOLOGICAL CHANGES

4.1 BODY WEIGHT

Month wise variation

Table 4.1.1 represents mean and standard deviations of total body weight, fat body weight and lean body weight across months. Due to unavailability of data in the months of January and March, ANOVA with repeated measurements was computed with the remaining 10 months of 19 cases.

ANOVA with repeated measurements revealed significant change in body weight ($F(9, 108) = 9.61$, $p<0.00$), fat body weight ($F(9, 108) = 9.74$, $p<0.00$) and lean body weight (F(9, 1080 = 2.86, $p<0.00$) across the months. Table 4.1.1 shows that Total body weight was high from May to November in comparison with the other months of the summer season. The body weight was highest in October (Mean = 78.38, SD = 6.32) and lowest in December (Mean = 73.43, SD = 8.10). Possibly this variation is due to more intake of calories in the winter season than in the summer season. This high calorie intake is essential to generate more heat needed in winter to maintain the internal body temperature and consequently for better physiological functioning in the cold environment.

Table 4.1.1
Month wise variation of Body Weight, Fat body Weight and Lean body Weight (in Kg)

Months	Body Weight		Fat Body Weight		Lean Body Weight	
	Mean	SD	Mean	SD	Mean	SD
February	74.38	6.75	12.54	3.08	61.88	7.36
April	75.92	7.37	14.38	4.23	61.54	7.53
May	77.00	7.35	16.31	3.86	60.69	8.08
June	77.54	7.28	16.31	4.79	61.31	7.63
July	77.15	7.29	18.08	4.42	59.00	6.84
August	76.92	7.75	17.62	4.01	59.62	7.58
September	76.92	6.38	17.31	3.45	59.62	7.35
October	77.77	6.66	17.00	4.81	60.77	6.98
November	77.38	6.93	17.08	4.05	60.23	6.78
December	73.85	7.01	13.77	3.27	60.17	7.31
F	9.61		9.74		2.86	
df	9,108		9,108		9,108	
Significance	0.00		0.00		0.00	

Like total body weight, fat body weight was also relatively high in the winter season, that is, from May to November, than in the summer season. It was highest in July (Mean = 18.08, SD = 4.42) and lowest in February (Mean = 12.54, SD = 3.08). This may be attributed to the high calorie intake in July than in the other months of winter since

July is the coldest month in Antarctica. On the other hand, the temperature was high in February, because of which the expeditioners could work more resulting in a loss of fat in February. For similar reason lean body weight was highest in February (Mean = 61.88, SD = 7.36) and lowest in July (Mean = 59.00, SD = 6.84).

4.2 BASAL METABOLIC RATE

Month wise Variation

Since BMR varies with body weight, initially zero order correlation coefficients were computed between body weight and BMR of 19 cases across 10 months (February, April, May, June, July, August, September, October, November and December). Very high significant and positive correlation coefficients between these two physiological parameters were noted (Table 4.2.1).

Table 4.2.1
Correlation Coefficients between
Body Weight and BMR (N = 19)

Cases	R
February	0.88**
September	0.86**
December	0.85**
August	0.85**
November	0.80**
June	0.77**
May	0.77**
April	0.77**
July	0.71**
October	0.66**

** $p<0.01$

Since body weight and BMR was significantly correlated it is important to classify the individuals into some homogeneous groups based on body weight in order to test significant variation of BMR level across months. Therefore all the cases were categorized into 3 homogeneous groups – High weight (Mean = 83.72, SD = 1.65 Kg, n = 9), Moderate weight ((Mean = 73.85, SD = 1.85 Kg, n = 6), and Low weight groups (Mean = 65.70, SD = 3.93 Kg, n = 4) based on their average body weight across 10 months. ANOVA with repeated measurements noted significant main effects of groups ($F(2,10) = 15.07$, $p<0.00$) and months ($F(9,90) = 2.41$, $p<0.02$) on differential pattern of BMR levels. Here BMR was the sum of BMR across 24 hours. No significant interaction effect between month and group ($F(18,90) = 0.52$, NS) was noted. This suggests that irrespective of group differences, BMR varied across months. Again, BMR levels of three groups varied differently across 10 months. Table 4.2.2 shows average BMR levels of people in three groups. For high weight groups, BMR varied from 1960.33 to 2073.33 kilo calories, for moderate weight group, it varied from 1701 to 1788.8 kilo calories and for low weight group, it varied from 1529 to 1632.7 kilo calories.

Table 4.2.2
Mean and Standard Deviation of BMR Levels of High, Moderate and Low Weight Groups

Months	High Weight		Moderate Weight		Low Weight	
	Mean	SD	Mean	SD	Mean	SD
February	2073.33	120.81	1788.75	39.54	1610.67	174.49
April	2052.17	111.85	1783.00	82.00	1630.33	268.76
May	2052.33	116.27	1743.25	75.60	1564.00	225.97
June	2054.33	133.78	1757.25	78.53	1607.33	213.74
July	1960.33	121.83	1701.00	118.22	1576.00	183.31
August	2014.50	107.16	1707.00	71.47	1529.00	139.54
September	2010.67	76.77	1710.25	148.31	1552.67	142.18
October	2012.50	128.66	1750.00	96.07	1632.67	200.52
November	1989.67	120.40	1763.50	122.22	1599.00	177.08
December	2008.66	124.34	1729.38	96.07	1601.25	226.10

4.3 TOTAL BODY WATER PERCENTAGE

Since Total body water or TBW varies with body weight, initially zero order correlation coefficients were computed between body weight and TBW of 19 cases across 10 months (February, April, May, June, July, August, September, October, November and December). Very high significant and positive correlation coefficients between these two physiological parameters were noted (Table 4.3.1).

Table 4.3.1
Correlation Coefficients between Body Weight And Total Body Water

Cases	r
February	0.89
April	0.76
May	0.82
June	0.82
July	0.72
August	0.88
September	0.88
October	0.67
November	0.86
December	0.88

**p<0.01

Since body weight and TBW was significantly correlated it is important to classify the individuals into some homogeneous groups based on body weight in order to test significant variation of TBW level across months. Therefore all the cases were categorized into 3 homogeneous groups – High weight (Mean = 83.72, SD = 1.65 Kg, n = 9), Moderate weight ((Mean = 73.85, SD = 1.85 Kg, n = 6), and Low weight groups (Mean = 65.70, SD = 3.93 Kg, n = 4) based on their average body weight across 10 months. ANOVA with repeated measurements noted significant main effects of groups ($F(2,10) = 20.44$, $p<0.00$) and months ($F(9,90) = 2.58$, $p<0.01$) on differential pattern of TBW levels. No significant interaction effect between month and group ($F(18,90) = 0.52$, NS) was noted. This suggests that irrespective of group differences, TBW varied across months. Again, TBW levels of three groups varied differently across 10 months. Table 4.3.2 shows average TBW levels of people in three groups. For high weight groups, TBW varied from 46.00% to 49.17%, for moderate group, it varied from 40.25% to 42.88% and for low group, it varied from 34.33% to 38.67%.

Table 4.3.2
Mean and Standard Deviation of TBW Levels of
High, Moderate and Low Weight Groups

Months	High Weight		Moderate Weight		Low Weight	
	Mean	SD	Mean	SD	Mean	SD
February	49.17	3.08	42.88	1.03	37.67	3.51
April	48.67	2.80	42.50	1.73	38.67	6.03
May	48.33	2.66	41.25	1.71	36.67	4.16
June	48.50	2.95	41.75	2.22	38.00	4.58
July	46.00	2.97	40.25	2.87	36.67	3.21
August	47.33	2.58	40.50	1.73	34.33	2.31
September	47.00	1.79	40.75	3.86	36.33	3.21
October	47.50	3.27	41.25	2.87	38.00	4.58
November	46.50	2.35	42.00	2.94	37.33	3.79
December	47.54	2.95	41.25	2.68	37.50	4.77

4.4 GALVANIC SKIN RESPONSE (GSR)

Month wise variation

Table 4.4.1 shows mean and standard deviations of GSR level across months. ANOVA with repeated measurement reveals significant variation of GSR level across months significantly ($F(9, 126) = 2.05$, $p<0.04$).

Table 4.4.1
Means and Standard Deviations of GSR (N=19)

Months	Mean	Minimum	Maximum	SD
February	455.50	395	586	49.67
April	457.88	395	629	51.80
May	478.83	387	657	66.34
June	469.74	376	624	56.36
July	488.24	385	633	58.83
August	490.47	416	620	56.09
September	486.33	405	601	54.91
October	479.13	387	615	59.21
November	475.37	389	621	49.54
December	465.08	387	612	50.60

Table 4.4.1 shows that GSR level increases from February and continues up to August and thereafter starts decreasing. This pattern is similar to the Yerkes Dodson curve. Following the model of Yerkes Dodson Law (Yerkes and Dodson, 1908) it can be said that psycho-physiological stress assessed by GSR initially increases and after the optimization level decreases smoothly. The figure shows occurrence of optimized stress in the month of August.

CHAPTER: 5

RESULTS OF PSYCHOLOGICAL CHANGES

5.1 GHQ-12

Month wise variation:

Table 5.1.1 shows that the GHQ score varied significantly across the months ($F(11,176) = 2.01$, $p < 0.03$). It followed a more or less alternating pattern of rise and fall across the months. The GHQ score was least in the month of January, showing thereby that in the summer month the mental stress is less than in the winter months. However, no significant between group variation was noted when ANOVA with Repeated Measurement was done between the scores of logistic personnel and that of the scientists. This suggests that the mental health of both the groups were similar with no marked differences between them.

Table 5.1.1

One-way ANOVA with Repeated Measurements of GHQ score

	df Effect	MS Effect	df Error	MS Error	F	p-level
Months	11	32.74	176.00	16.30	2.01	0.03

Table 5.1.2

Month Wise Distribution of GHQ Score

Name Code	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	14	24	12	12	14	12	12	12	18	12	12	12
2	17	12	13	14	14	13	12	14	12	17	13	14
3	22	20	19	19	21	20	22	23	23	23	25	18
4	28	18	21	17	23	21	21	20	16	20	19	19
5	17	20	20	20	19	0	17	17	21	17	18	20
6	0	13	16	12	12	12	12	0	12	12	12	12
7	0	13	12	20	22	14	23	16	16	15	16	12
8	0	0	19	14	15	13	13	13	13	12	12	12
9	17	18	16	17	17	16	14	14	15	14	15	15
10	13	14	12	13	12	13	13	12	12	12	12	13
11	17	26	21	18	15	16	17	18	16	19	12	13
12	12	12	11	12	12	12	11	12	12	12	12	12
13	21	26	24	23	23	20	20	22	18	22	19	23
14	21	16	19	17	22	22	24	20	21	17	17	20
15	19	22	15	14	20	19	20	19	17	23	23	22
16	13	12	14	12	12	11	14	12	13	13	12	12
17	0	16	12	29	27	18	16	12	12	12	12	12
18	0	15	15	28	23	17	22	19	17	19	26	23

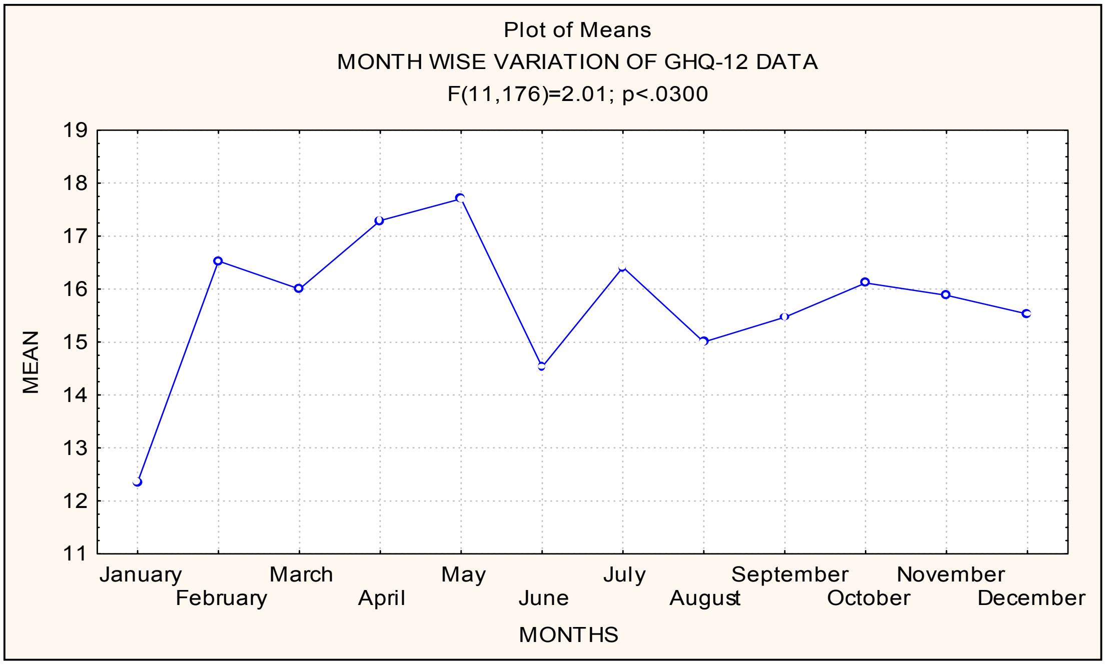

Fig. 5.1.1
Month Wise Variation of GHQ Score

5.2 LIFE EVENTS

Classification of Life events

Initially, number of cases scored less than 3 for each item across each month were identified. The frequencies were converted into percentages. Table 3.3.2.1 represents percentage distribution of each item irrespective of months. Based on the percentage distribution, the 21 life events were categorized into four categories – high (percentage higher than 50%), moderate (25-50%), low (10 to 24%) and least stressful life events (less than 10%).

High stressful life events were low temperature (64.85%), high wind speed (63.03%) and use of protectors (50.30%). Moderate stressful life events were light reflected from snow (42.42%), snow fall (34.55%), light reflected from white clouded sky and major change in sleeping habits (33.94%), major change in eating habits (29.09%), freezing exposed skin (27.27%). Low stressful events were disappearance of horizon (24.24%), loss of depth perception (21.82%), periodic loss of radio communication (18.18%), sunburn (17.58%), lowering of body temperature (16.36%), major change in drinking habits (15.76%). Least stressful life events were crossing snow bridge (6.06%), passing high altitude (4.85%), stormy sea (1.82%), food shortage (1.21%), isolation from team (0.61%). It was found that shortage of medicines were not their problems.

High Stressful life events

Of the three high stressful life events, low temperature varied widely across months (Maximum = 86.67%, Minimum = 33.33%). More than 50% of the sample experienced low temperature stress in May (86.67%), April (80%), July and August (73.33%), June and October (66.67%), February, September and November (60%) and in March (53.33%). They experienced low stress in December (33.33%).

The second high stressful life events was high wind speed (Max = 73.33%, Min=33.33%). More than 50% of cases experienced high wind speed stress in April, July, August and October (73.33%), February, May, June and September (66.67%) and in November (60%). They experienced low stress in March (40%) and December (33.33%).

The third high stressful life events was use of protector (Max = 60%, Min=40%). More than 50% of cases experienced use of protector stress in September and November (60%), June, July, August, October and December (53.33%). They experienced low stress in May (46.67%), February, March and April (40%).

Moderate Stressful life events

Of the six moderate stressful life events, light reflected from snow varied most widely across eleven months (Max = 66.67%, Min =0.00%). More than 50% of cases experienced this stress in February and October (66.67%), March, April, September, November and December (53.33%). Next stressful event was light reflected from white clouded sky (Max = 60%, Min =0%). More than 50% of cases experienced this stress in October (60%), February, November and December (53.33%). More than 50% of cases snow fall stress in April (60%), and in May (53.33%). Major change in sleeping habits was experienced by more than 50% of cases in February (53.33%).

Low Stressful Life events

Of the six low stressful life events, disappearance of horizon was relatively high in April and October (40%) and loss of depth perception was relatively high in October (46.67%).

Least Stressful Life events

Of the five least stressful life events, few experienced crossing snow bridge stress in November (20%), passing high altitude stress in February and March (13.33%).

To sum up, four categories of stressful life events were identified based on the average percentage of cases to each item. It was noted that high and moderate stressful life events were mainly related to atmosphere and habit. Most of the stress experiences occurred in February, April and May. This may be due to anticipation of stress during the deep winter months, July and August. But stress experience was relatively low in July and August. This may be due to adaptation of environmental stress or may be due to staying within the safety enclosure.

Table 5.2.1
Distribution of Life events across Months

Sl.	Items	Feb		Mar		Apr		May		Jun	
		F	%	F	%	F	%	F	%	F	%
	Atmospheric Stress										
1	Low temperature	9	60.00	8	53.33	12	80.00	13	86.67	10	66.67
2	High wind speed	10	66.67	6	40.00	11	73.33	10	66.67	10	66.67
3	Snowfall	5	33.33	1	6.67	9	60.00	8	53.33	6	40.00
4	Light reflected from snow	10	66.67	8	53.33	8	53.33	3	20.00	1	6.67
5	Light reflected from white clouded sky	8	53.33	4	26.67	5	33.33	3	20.00	1	6.67
6	Disappearance of horizon	3	20.00	3	20.00	6	40.00	4	26.67	5	33.33
7	Loss of depth perception	4	26.67	3	20.00	3	20.00	3	20.00	3	20.00
8	Stormy sea	1	6.67	1	6.67	0	0.00	0	0.00	0	0.00
	Health Stress										
9	Food shortage	1	6.67	0	0.00	0	0.00	0	0.00	1	6.67
10	Shortage of medicine	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11	Freezing exposed skin	3	20.00	4	26.67	7	46.67	7	46.67	3	20.00
12	Use of protector	6	40.00	6	40.00	6	40.00	7	46.67	8	53.33
13	Sun burn	3	20.00	4	26.67	5	33.33	0	0.00	0	0.00
14	Lowering of body temperature	3	20.00	3	20.00	1	6.67	2	13.33	4	26.67
15	Major change in sleeping habits	8	53.33	4	26.67	4	26.67	6	40.00	7	46.67
16	Major change in eating habits	6	40.00	3	20.00	5	33.33	5	33.33	6	40.00
17	Major change in drinking habits	4	26.67	1	6.67	3	20.00	2	13.33	3	20.00
	Social Stress										
18	Periodic loss of radio communication	5	33.33	4	26.67	4	26.67	4	26.67	4	26.67
19	Isolation from team	0	0.00	1	6.67	0	0.00	0	0.00	0	0.00
	Movement Stress										
20	Passing high altitude	2	13.33	2	13.33	0	0.00	0	0.00	0	0.00
21	Crossing snow bridge	2	13.33	1	6.67	2	13.33	0	0.00	0	0.00

l.	Items	Jul		Aug		Sep		Oct		Nov		Dec	
		F	%	F	%	F	%	F	%	F	%	F	%
	Atmospheric Stress												
1	Low temperature	11	73.33	11	73.33	9	60.00	10	66.67	9	60.00	5	33.33
2	High wind speed	11	73.33	11	73.33	10	66.67	11	73.33	9	60.00	5	33.33
3	Snowfall	6	40.00	4	26.67	5	33.33	6	40.00	2	13.33	5	33.33
4	Light reflected from snow	0	0.00	6	40.00	8	53.33	10	66.67	8	53.33	8	53.33
5	Light reflected from white clouded sky	0	0.00	5	33.33	5	33.33	9	60.00	8	53.33	8	53.33
6	Disappearance of horizon	3	20.00	2	13.33	5	33.33	6	40.00	3	20.00	0	0.00
7	Loss of depth perception	2	13.33	2	13.33	5	33.33	7	46.67	3	20.00	1	6.67
8	Stormy sea	0	0.00	0	0.00	0	0.00	0	0.00	1	6.67	0	0.00
	Health Stress												
9	Food shortage	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10	Shortage of medicine	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11	Freezing exposed skin	6	40.00	6	40.00	3	20.00	3	20.00	2	13.33	1	6.67
12	Use of protector	8	53.33	8	53.33	9	60.00	8	53.33	9	60.00	8	53.33
13	Sun burn	0	0.00	2	13.33	2	13.33	3	20.00	5	33.33	5	33.33
14	Lowering of body temperature	4	26.67	3	20.00	2	13.33	4	26.67	0	0.00	1	6.67
15	Major change in sleeping habits	7	46.67	5	33.33	2	13.33	3	20.00	4	26.67	6	40.00
16	Major change in eating habits	6	40.00	2	13.33	2	13.33	2	13.33	5	33.33	6	40.00
17	Major change in drinking habits	4	26.67	0	0.00	1	6.67	3	20.00	2	13.33	3	20.00
	Social Stress												
18	Periodic loss of radio communication	2	13.33	3	20.00	1	6.67	0	0.00	1	6.67	2	13.33
19	Isolation from team	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Movement Stress												
20	Passing high altitude	1	6.67	1	6.67	0	0.00	1	6.67	1	6.67	0	0.00
21	Crossing snow bridge	0	0.00	0	0.00	1	6.67	0	0.00	1	6.67	3	20.00

Table 5.2.2
Range of Percentage Distribution of Life Events

Items	Average	Maximum	Minimum
Atmospheric Stress			
Low temperature	64.85	86.67	33.33
High wind speed	63.03	73.33	33.33
Snowfall	34.55	60.00	6.67
Light reflected from snow	42.42	66.67	0.00
Light reflected from white clouded sky	33.94	60.00	0.00
Disappearance of horizon	24.24	40.00	0.00
Loss of depth perception	21.82	46.67	6.67
Stormy sea	1.82	6.67	0.00
Health Stress			
Food shortage	1.21	6.67	0.00
Shortage of medicine	0.00	0.00	0.00
Freezing exposed skin	27.27	46.67	6.67
Use of protector	50.30	60.00	40.00
Sun burn	17.58	33.33	0.00
Lowering of body temperature	16.36	26.67	0.00
Major change in sleeping habits	33.94	53.33	13.33
Major change in eating habits	29.09	40.00	13.33
Major change in drinking habits	15.76	26.67	0.00
Social Stress			
Periodic loss of radio communication	18.18	33.33	0.00
Isolation from team	0.61	6.67	0.00
Movement Stress			
Passing high altitude	4.85	13.33	0.00
Crossing snow bridge	6.06	20.00	0.00

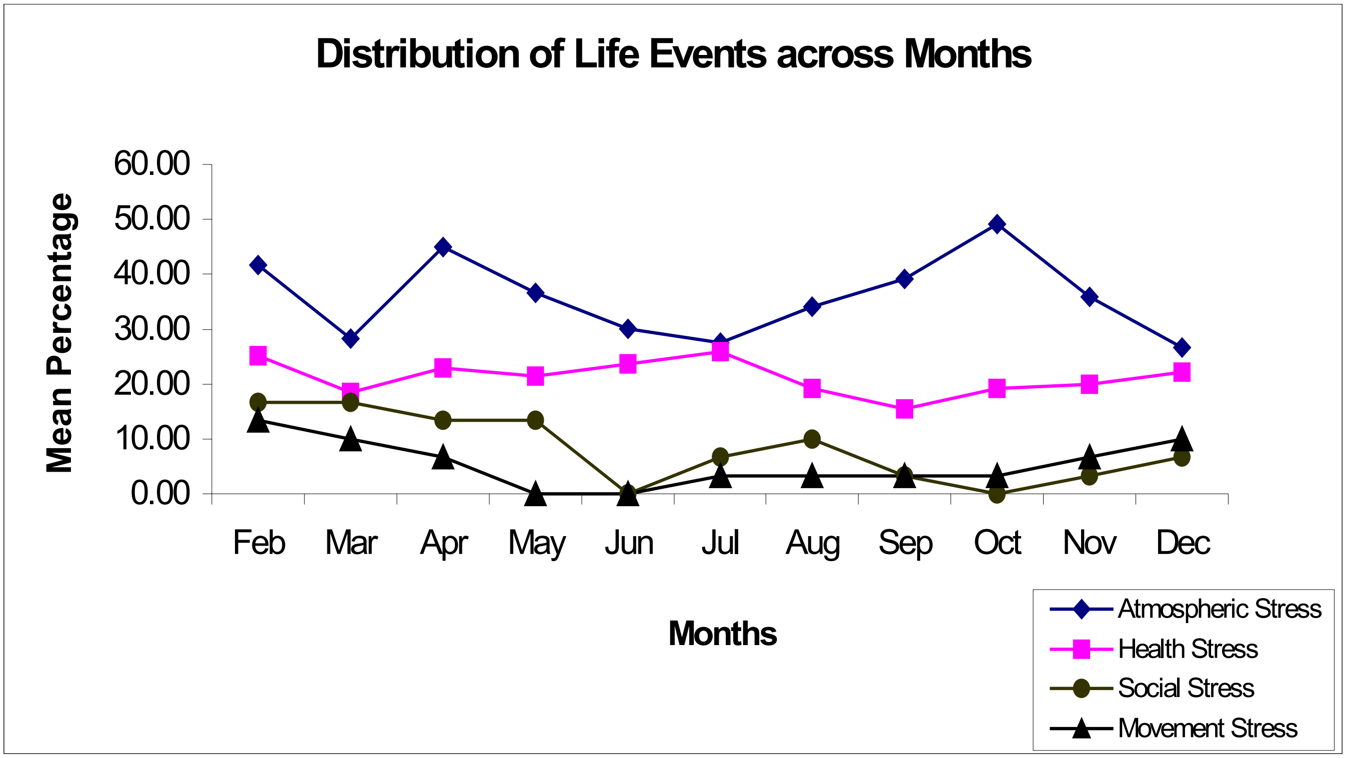

Fig. 5.1.2
Distribution of Life Events across Months

CHAPTER: 6

CORRELATION AMONG ATMOSPHERIC, PHYSIOLOGICAL AND PSYCHOLOGICAL DATA

6.1 Correlation among atmospheric Variables

Figure 6.1 shows variation of atmospheric variables with respect to average distribution across months. But it can not be understood from this data that whether this variation maintains specific trend with other variables or not. Therefore, Spearman Rank order correlation coefficients were calculated in order to find out month wise similarity among different atmospheric variables,. Table 6.1 shows that wind speed was negatively related to sea level (Rho(10) = -0.65, $p<0.05$) and station pressure (Rho(10) = -0.63, $p<0.05$). This inverse relationship is due to the natural tendency of wind to blow from higher pressure regions to regions at lower pressure along the pressure gradient. As expected station and sea level pressure was significantly correlated. (Rho(10) = 0.99, $p<0.01$) No significant relationship was found between temperature and other atmospheric variables.

Table 6.1.1
Rank order correlation matrix of atmospheric variables (N=10)

		1	2	3	4
1	Wind speed	1.00			
2	Temperature	0.10	1.00		
3	Sea pressure	-0.65*	0.28	1.00	
4	Station pressure	-0.63*	0.30	0.99**	1.00

6.2 Correlation among Physiological Variables

Chapter 4 shows significant differences in four physiological variables. But it can not be understood from this data that whether this variation maintains specific trend with other variables or not. In order to examine pattern of functional relationship among the variables, Pearson product moment correlation coefficient was made. Table 6.2 shows significant correlation among body weight, basal metabolic rate, total body water and galvanic skin response. Intake of more food requires intake of more water. Possibly for this reason, the study revealed significant positive correlation ($r(176) = 0.78$, $p<0.01$) between body weight and total body water. Again intake of more food results in the production of more energy. That may be one of the reasons for significant positive correlation ($r(176) = 0.76$, $p<0.01$)between body weight and BMR.

Results show significant negative correlation coefficients of GSR with other physiological variables. GSR was more related to TBW ($r(176)= -0.81$, $p<0.01$), than BMR ($r(176)= -0.76$, $p<0.01$), and body weight ($r(176)= -0.50$, $p<0.01$). This indicates physiological adaptation to the experience of tension. In other words, individual takes more water and food in order to cope with the tension.

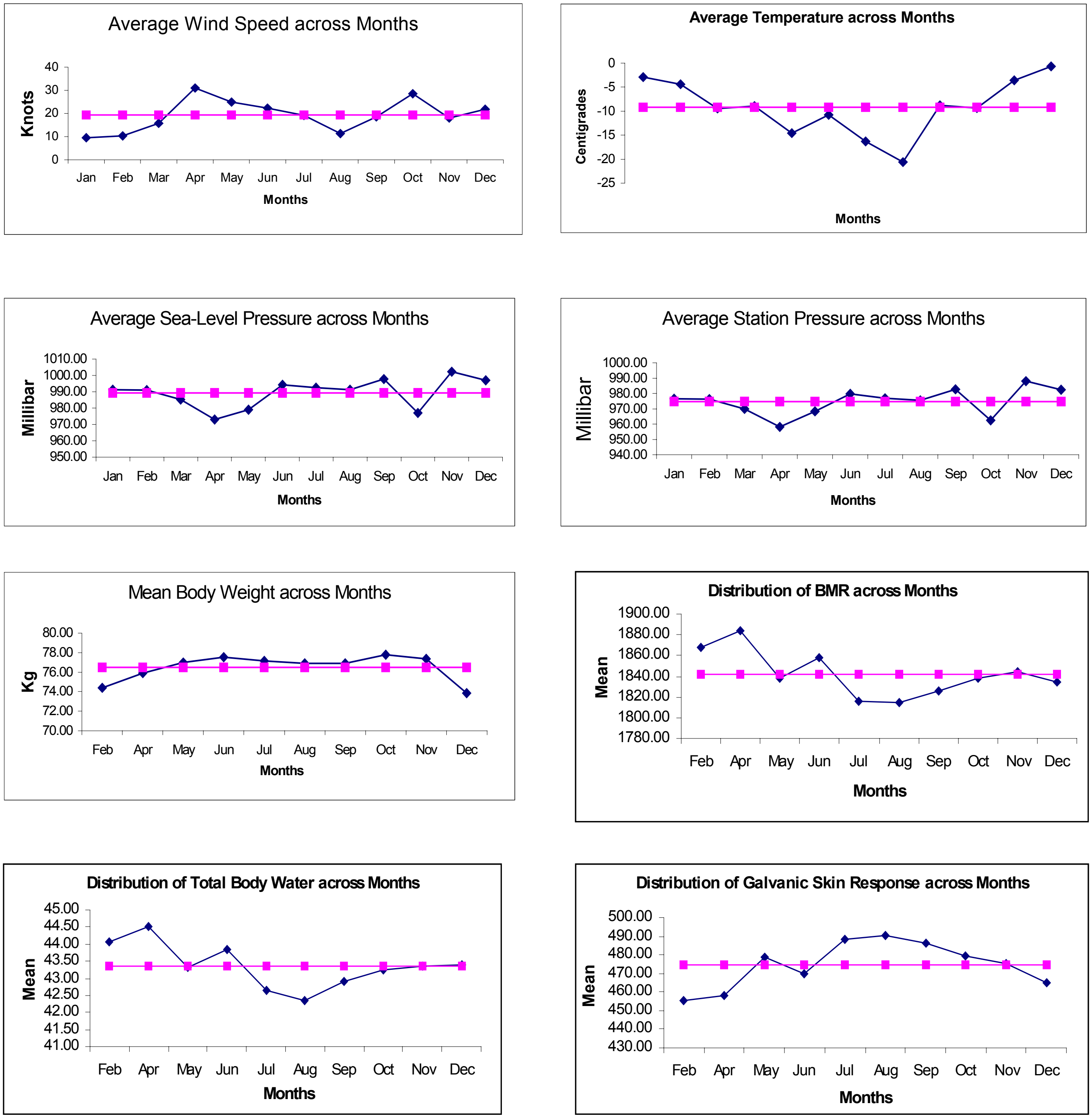

Figure 6.1.1
Distribution of all the parameters across months

Table 6.2.1

Correlation matrix of Psychological and Physiological Variables (N=176)

	Mean	SD	1	2	3	4	5
1.Mental Health	16.18	4.75	1.00				
2.Body Weight	76.15	7.47	-0.27	1.00			
3.Basal Metabolic Rate	1832.67	202.15	-0.29	0.76	1.00		
4.Total Body Water	43.13	4.85	-0.28	0.78	0.98	1.00	
5.Galvanic Skin Response	477.41	55.52	0.27	-0.50	-0.76	-0.81	1.00

Note: All correlation coefficients were significant at 0.01 level.

6.3 Correlation among Psychological Variables

Table 6.3 shows that GHQ-12 score was significantly related to low temperature (r(210) = -0.28, p<0.01), major change in sleeping (r(210) = -0.25, p<0.01) and eating habits (r(210) = -0.22, p<0.01) high wind speed 9r(210) = -0.18), use of protector (r(210) = -0.18) of Life events scale.

Table 6.3.1

Correlation between the Life Events score and GHQ-12 scores

Life Event	GHQ (N=210)
Low temperature	-0.28*
High wind speed	-0.18
Snowfall	-0.04
Light reflected from snow	-0.08
Light reflected from white clouded sky	-0.05
Disappearance of horizon	-0.01
Loss of depth perception	-0.01
Periodic loss of radio communication	-0.01
Food shortage	0.10
Stormy sea	0.13
Shortage of medicine	0.04
Freezing exposed skin	-0.13
Isolation from team	0.03
Use of protector	-0.18*
Sun burn	0.04
Passing high altitude	0.06
Lowering of body temperature	-0.02
Crossing snow bridge	0.09
Major change in sleeping habits	-0.25*
Major change in eating habits	-0.22*
Major change of drinking habits	-0.07

* p<0.01

CHAPTER : 7

PHYSIOLOGICAL CHANGES OF MORE AND LESS PSYCHOLOGICAL DISTRESSED GROUPS

7.1 Identification of more and less psychological distressed groups

In this study high score on GHQ-12 indicates more psychological distress. Initially, GHQ scores for each month was averaged. The respondents who scored higher than average value for each month more than 50% of times were classified as less psychological distressed respondents and vice versa. Table 7.1 shows that 8 cases out of 18 gave more than 50% of times higher score.

Table 7.1
Distribution of more and less psychological distressed groups

N_Code	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Freq	%	
1	2	2	1	1	1	1	1	1	2	1	1	1	3	25	
2	2	1	1	1	1	1	1	1	1	2	1	1	2	17	
3	2	2	2	2	2	2	2	2	2	2	2	2	12	100	P
4	2	2	2	1	2	2	2	2	2	2	2	2	11	92	P
5	2	2	2	2	2	1	2	2	2	2	2	2	11	92	P
6	1	1	1	1	1	1	1	1	1	1	1	1	0	0	
7	1	1	1	2	2	1	2	2	2	1	2	1	6	50	
8	1	1	2	1	1	1	1	1	1	1	1	1	1	8.3	
9	2	2	1	1	1	2	1	1	1	1	1	1	3	25	
10	2	1	1	1	1	1	1	1	1	1	1	1	1	8.3	
11	2	2	2	2	1	2	2	2	2	2	1	1	9	75	P
12	1	1	1	1	1	1	1	1	1	1	1	1	0	0	
13	2	2	2	2	2	2	2	2	2	2	2	2	12	100	P
14	2	1	2	1	1	2	2	2	2	2	2	2	9	75	P
15	2	2	1	1	2	2	2	2	2	2	2	2	10	83	P
16	2	1	1	1	1	1	1	1	1	1	1	1	1	8.3	
17	1	1	1	2	2	2	1	1	1	1	1	1	3	25	
18	1	1	1	2	2	2	2	2	2	2	2	2	9	75	P

7.2 Month wise GHQ-12 scores of more and less psychological distressed groups

Table 7.2 presents the Mean and standard deviations of more and less psychological distressed groups across months. Except April and June months, the more psychological distressed group possessed high scores on GHQ-12 than the low scores in a significant manner.

Table 7.2
Means and standard deviations of more and less psychological distressed across months.

	High Stress			Low Stress					
	Mean	SD	N	Mean	SD	N	t	df	Sig
January	20.71	3.77	7	14.33	2.16	6	3.65	11	0.01
February	20.38	4.14	8	13.40	6.02	10	2.78	16	0.01
March	19.25	3.06	8	13.70	2.54	10	4.21	16	0.01
April	17.13	8.15	8	15.50	5.42	10	0.51	16	Ns
May	20.71	2.98	7	15.70	5.06	10	2.34	15	0.05
June	16.88	7.10	8	13.40	2.12	10	1.48	16	Ns
July	20.38	2.45	8	14.00	3.46	10	4.39	16	0.01
August	19.75	1.98	8	11.70	4.32	10	4.85	16	0.01
September	18.63	2.67	8	13.50	2.12	10	4.55	16	0.01
October	20.00	2.45	8	13.10	1.73	10	7.01	16	0.01
November	19.88	4.61	8	12.80	1.48	10	4.6	16	0.01
December	19.75	3.28	8	12.60	1.07	10	6.5	16	0.01
Total	19.43	4.24	94	13.62	3.56	116	10.78	208	0.0001

7.3 Differences in physiological variables between the groups

In the earlier chapter it was noted that physiological parameters were significantly related to each other. Therefore MANOVA was computed between strong and weak mental health groups for each month. Table 7.3 presents results of MANOVA. It shows that month and interaction between month and group had no significant effects on changes in physiological parameters. Only group (Rao's R = 4,146) = 12.34, $p<0.001$) had significant effect on the changes. Table 7.4 shows Means and standard deviations of four physiological parameters between the groups across months. Strong mental health group possessed significantly lower score in GSR but higher score in body weight, total body water and basal metabolic rate than the weak mental health group.

Table 7.3
MANOVA between more and less psychological distressed groups

	Wilks' Lambda	Rao's R	df 1	df 2	p-level
Month	0.72	1.42	36	548	0.06
Group	0.75	12.34	4	146	0.00
Month X Group	0.90	0.44	36	548	1.00

Table 7.4
Means and Standard deviations of Physiological parameters
Of more and less psychological distressed groups

		BODY_WT_		BMR		TBW		RES		
Months	Groups	M	SD	M	SD	M	SD	M	SD	N
February	Strong	75.83	5.93	1936.67	164.57	45.89	3.81	432.50	27.85	9
	Weak	70.75	8.40	1789.19	235.17	42.00	5.73	481.38	57.51	8
April	Strong	77.67	6.46	1954.78	157.31	46.44	3.71	429.22	15.69	9
	Weak	64.14	29.34	1536.29	721.17	36.14	16.83	423.14	197.21	7
May	Strong	79.50	6.75	1896.00	156.77	44.80	3.58	455.30	33.04	10
	Weak	73.57	8.83	1752.00	273.38	41.14	6.41	513.57	92.15	7
June	Strong	79.90	6.40	1922.80	171.96	45.70	3.74	445.20	31.46	10
	Weak	73.63	8.50	1748.38	212.43	40.75	4.86	512.13	52.22	8
July	Strong	78.44	6.84	1850.78	188.16	43.56	4.50	481.89	44.80	9
	Weak	74.00	9.45	1758.29	233.52	41.14	5.52	503.00	76.70	7
August	Strong	78.89	7.24	1877.00	196.73	43.78	5.59	469.89	45.46	9
	Weak	73.43	8.34	1714.57	213.79	39.86	4.74	527.57	49.68	7
September	Strong	78.67	5.59	1893.33	169.74	44.67	3.81	461.44	36.96	9
	Weak	73.75	8.35	1728.63	235.94	40.25	5.55	524.50	48.53	8
October	Strong	80.00	6.04	1882.80	180.36	44.40	4.45	465.30	50.96	10
	Weak	75.67	6.35	1765.33	198.98	41.33	4.84	502.17	69.45	6
November	Strong	80.00	6.53	1895.50	141.35	44.80	2.94	454.40	26.28	10
	Weak	74.63	8.26	1755.38	214.76	40.88	4.79	512.38	46.51	8
December	Strong	75.72	6.40	1891.12	165.87	44.92	3.91	442.88	15.77	10
	Weak	69.78	7.30	1733.47	217.42	40.63	5.09	502.59	55.51	8

SUMMARY

1. Visibility level in Antarctica is mostly within the range of less than 50 to 1 kilometer in May, June, July and August. And it is within the range of 4 to 10 kilometers mostly from October to March. Synoptic variation of visibility level is noted. But it varies across months.
2. Chi-square test revealed significant difference in direction of wind movement across months. Though predominant directions of wind movement are east-southeast and southeast, it varies in summer and winter months. In summer season wind blow was high from south–southwest and southwest and northeast than in the winter season. On the other hand wind blow was high from east-southeast, southeast, east, south and south-southeast in winter season. No significant difference in synoptic variation and months was noted.
3. ANOVA revealed significant variation of wind speed. Average Wind speed varied from 9.59 knots to 30.96 knots significantly. It was high from April to July and was low from January to March. Synoptic variation and its interaction with months had no significant impact on variation of wind speed.
4. Average temperature varied from -0.67^{0} centigrade to -20.60^{0} centigrade. The area was very cold from May to August and relatively less cold from November to February significantly. Synoptic variation and its interaction with months had no significant impact on variation of temperature.
5. Average sea level pressure ranged from 973.02 mb (April) to 1002.31 mb (November). Significantly it was relatively low in April , May and October and was high in June, September, November, March and December.
6. Mean station level pressure was lower than mean sea level pressure. Variation of station level pressure ranged from 958.15 mb (April) to 987.90 mb (November). Like station pressure, it was relatively low in March, April, May and October and high in June, September, November and December.
7. ANOVA with repeated measurements revealed significant mean differences in body weight across months. Body weight was relatively low in December, April and February. From May to November, body weight was almost similar.
8. Body weight and BMR was significantly correlated. ANOVA with repeated measurements revealed significant mean differences in BMR levels among high, moderate and low body weight groups across months. No significant interaction effect of month and group on BMR was noted.
9. Body weight and total body water (TBW) was significantly and positively related. ANOVA with repeated measurements revealed significant mean differences in TBW levels among high, moderate and low body weight groups across months.
10. Galvanic skin response (GSR) varied across months. Mean distribution of GSR follows almost similar to bell shaped curve indicating physiological adaptation of stress. It was increasing slowly from February and just after August, it was slowly decreasing.
11. GHQ-12 scores varied across months. Like GSR, it was increasing slowly from January and after the month of May instead of July, it decreases slowly but it again went up July.
12. Life event scale identified four events as more stressful. They are low temperature, high wind speed, use of protector, and light reflected from snow.
13. Wind speed was negatively related to sea and station pressure. Temperature was not significantly related to wind speed, sea and station pressures.
14. GHQ-12 scores were negatively related to body weight, BMR, TBW and positively related to GSR in a significant manner.

15. Based on GHQ scores across months, respondents were classified into two groups – more and less psychological distressed groups. Less psychological distressed groups significantly possessed lower scores in GHQ-12 scales than the more psychological distressed groups.
16. MANOVA noted that less psychological distressed group possessed significantly high values on body weight, total body water and basal metabolic rate than more psychological distressed group.
17. More psychological distressed group possessed lower level of GSR than less psychological distressed group significantly.

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APPENDIX A

GENERAL HEALTH QUESTIONNAIRE

Here are some statements related to your health and wellbeing. Please indicate how frequently you experience following item description by encircling your chosen number.

Items	Always	More frequently	Frequently	Less frequently	Least Frequently
1. I am able to concentrate on whatever I am doing	1	2	3	4	5
2. I lost much sleep over worry	1	2	3	4	5
3. I felt that I am playing a useful part in things	1	2	3	4	5
4. I felt capable of making decisions about things	1	2	3	4	5
5. I felt constantly under strain	1	2	3	4	5
6. I felt I couldn't overcome difficulties	1	2	3	4	5
7. I am able to enjoy my normal day-to-day activities	1	2	3	4	5
8. I am able to face upto your problems	1	2	3	4	5
9. I feel unhappy and depressed	1	2	3	4	5
10. I am loosing confidence in myself	1	2	3	4	5
11. I am thinking myself as a worthless person	1	2	3	4	5
12. I am feeling reasonably happy all things considered	1	2	3	4	5

APPENDIX B

LIFE EVENTS SCALE

Following are some changes in physical and social environment in Antarctica. Please encircle your chosen number to indicate how frequently you experience stress in those events.

Items	Always	More frequently	Frequently	Less frequently	Least frequently
1. Low temperature	1	2	3	4	5
2. High wind speed	1	2	3	4	5
3. Snowfall	1	2	3	4	5
4. Light reflected from the snow surface	1	2	3	4	5
5. Light reflected from the white clouded sky	1	2	3	4	5
6. Disappearance of horizon	1	2	3	4	5
7. Loss of depth perception	1	2	3	4	5
8. Periodic loss of radio communication	1	2	3	4	5
9. Food shortage	1	2	3	4	5
10. Stormy sea	1	2	3	4	5
11. Shortage of medicines	1	2	3	4	5
12. Freezing exposed skin	1	2	3	4	5
13. Isolation from the team	1	2	3	4	5
14. Use of protector	1	2	3	4	5
15. Sun burn	1	2	3	4	5
16. Passing on high altitude	1	2	3	4	5
17. Lowering of body temperature	1	2	3	4	5
18. Crossing snow bridge	1	2	3	4	5
19. Major change in sleeping habits	1	2	3	4	5
20. Major change in eating habits	1	2	3	4	5
21. Major change in drinking habits	1	2	3	4	5