

## Background of the survey

A field survey on a sample from a population provides an insight regarding the general comparisons and values of different biological parameters. Biological parameters are highly variable in nature from individual to individual and even in same individual from time to time. There are various features responsible for these variations - age, sex, habit, habitat, workload, genetics etc.

It is evident that an individual's belonging from high altitude regions have high physical capabilities and better physiological parameters to fitness than that of an individual of plainland. A high altitude environment lacks enough partial oxygen pressure in the atmosphere but also lacks environmental pollutants. The daily activity of the people often involves strenuous musculoskeletal work and cardiovascular functions. The hereditary endowments constitute to the body's parameters and composition.



Their diet is also a factor for their physique. Socio-economic status and ethnicity also contribute towards the individual's nutrition and body composition. Sometimes, underlying health complications and diseases may exert their variations.

A general study of these parameters and indices give us a concept of the overall health of the subject or a group of subjects. Various surveys are performed by the Ministry of Health and Welfare and as well as by NGOs actively. Various committees such as Bhole committee are also set up with a notion of scavenging existing position of India regarding health conditions and also to make recommendations to improve the public health system of India. 'All India anthropometric survey' - collects basic morphological data and portrays a general picture of physique of any population.

These collections of data are important in studying variations in parameters and indices over different locations

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## Aim of the survey

The goal of the survey was to evaluate the demographic, physiological and anthropometric variables in adults of comparatively higher altitude.

## Methodology

### Study Design and study area

An educational excursion was planned under the guidance of our teachers and head of the Department of Physiology and Principal of our college. The tour was extended from 8<sup>th</sup> March, 2024 to 14<sup>th</sup> March, 2024 excluding the journey period to Sikkim and during this period, the field survey was conducted on the local people of Sikkim.

The field survey was conducted at a height of around 1500 m from the sea level. The subjects (local people) took part in the survey voluntarily and were given a brief description about the survey work by our teachers and students. They could also leave the survey at any time if they were unwilling.



## Collection of Data

The name, age, sex of the subjects were asked and 10 different parameters were collected from each of them. A structured plan for the collection of all the data was designed as such that a few groups were formed. Each group comprised of 2 to 3 students (surveyors) to measure the parameters

Group	Parameters	Apparatus
1. Cardiac Index	a) Blood pressure b) pulse rate	Sphygmomanometer stethoscope, stopwatch
2. Anthropometry I	a) Waist circumference b) Hip circumference	Metal tape
3. Anthropometry II	a) Height b) weight	Anthropometric rod weight scale
4. Anthropometry III	a) Head length b) Head breadth	Spreading callipers
5. Peak flow	Peak expiratory flow rate	Peak flow meter
6. Vertical jump	a) Jump height b) Standing height	Metal tape
7. Body composition	a) Skin fold thickness	skin fold calliper
Age, Sex	-	Questionnaire

Table 1: Assessment of Physical Parameter



Blood pressure was measured using a sphygmomanometer and tying cuff at two inches above the brachial artery and placing stethoscope on the brachial artery. Elevation and fall of pressure inside the cuff gave the Korotkoff sounds and the readings of systolic and diastolic pressures were noted.

Pulse rate was recorded by placing two fingers on the radial artery with slight pressure and counting each beat of arterial rhythm while tracking the time on stop watch.

Waist and hip circumference were measured using non-stretchable metal tape by encircling it around two inches above the belly button and around the widest part of the hips. During measurements, minimum clothings were prescribed.

Height was measured using anthropometric rod with nearest value up to 1 cm. The subject was asked to take off the shoes.

Weight was also measured on a portable weighing machine with shoes off and little dress and accessories.

Head length and breadth were measured using spreading callipers while the subject was asked to sit on chair and

relaxed condition facing straight.

For vertical jump, the subject was asked to stand by a clean wall as close as possible and his/her standing height was measured with hand stretched upward along the wall as standing reach height. Thereafter, the subject was told to jump as high as possible with chalk dust at the tip of his/her finger and touch the wall. The maximum point on the wall touched by them was measured using metal tape and was noted as jump height.

Skin fold thickness was measured around triceps, supra-ileum, thigh for female and around chest, abdomen, thigh for male while keeping minimum clothing around those areas if possible. Hexpendent skin fold calliper was used to measure the skin fold thickness.



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## Study Variables

Biological parameters are the variables which are measured directly using apparatus. Some indices are very important for comparative study. Such indices were studied from collected physical and physiological parameters.

Parameters	Formula
1. Waist - Hip ratio	$\frac{\text{Waist circumference}}{\text{Hip circumference}}$
2. BMI (Body Mass index)	$\frac{\text{Mass (kg)}}{\text{Height (m}^2\text{)}}$
3. PI (Ponderal index)	$\frac{\text{Mass (kg)}}{\text{Height (m}^3\text{)}}$
4. BSA (Body surface area)	$\text{Weight (kg)}^{0.425} \times \text{Height (m)}^{0.725} \times 71.84$
5. Jump score	$\text{Jumping height (cm)} - \text{Standing reach height (cm)}$
6. PAP <sub>w</sub> (Peak anaerobic power output)	$(60.7 \times \text{jump height}) + (45.3 \times \text{weight}) - 2055$
7. Body Density	$1.099921 - 0.0009929 (\text{sum of 3 readings of skinfold}) + 0.0000023 (\text{sum of 3 readings})^2 - 0.0001392 (\text{Age})$
8. Body fat percentage	$[(4.95 \div \text{body density}) - 4.5] \times 100$

Table 2 : Formula for calculation of various parameters

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## Sorting of Raw data

A total of 58 subjects from a population were enrolled in the survey. Basic sorting was done with the raw data. 28 samples were rejected during the process due to various reasons.

Subjects participated in survey (n=58)

↓  
Subjects with complete data sets (n=45)

↓ 10 subjects fell in other targeted age, sex groups  
Subjects fit for aimed sample groups (n=35)

↓  
Two subjects were rejected due to measurement error

↓  
Subjects with valid data (n=33)

↓ 3 samples were rejected to form groups of equal sample size  
Subjects in the final report (n=30)

## Flowchart: Sorting of raw data

On completion of selecting samples, they were grouped based on their age, sex. Three age groups (21-30, 31-40, 41-50 years) were formed and each consisted of 6 males (n=6) and 4 females (n=4)





## Statistical analysis

To summarize data, quantitative variables (continuous) were analyzed by calculating the simple mean and standard deviation of each group. Independent student's t-test was done between two sex groups under each age group for analysis of the differences.

## Results

All the variables were analyzed and expressed in tabular and graphical form and in their respective groups and sexes. t-score is compared with standard value chart to determine if there is any significant difference at  $\alpha = 0.05$  and  $df = 8$

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	Variables (unit)	Values in male (mg)	Values in female (mg)	t score
1.	Stature (cm)	166.63 ± 8.01	151 ± 2.34	4.2500*
2.	Weight (kg)	59.5 ± 14.40	60.25 ± 13.72	0.0830
3.	BMI (kg/m <sup>2</sup> )	21.18 ± 2.80	26.29 ± 4.96	2.1067
4.	PI (kg/m <sup>3</sup> )	12.67 ± 1.10	17.37 ± 2.95	3.632*
5.	BSA (m <sup>2</sup> )	1.6602 ± 0.2218	1.5526 ± 0.1663	0.8220
6.	BP (mm of Hg)	-	-	-
-	• Systolic	125.3 ± 9.2	128.5 ± 9.8	0.5250
-	• Diastolic	78.3 ± 4.8	75.3 ± 6.02	0.4870
7.	Pulse rate (beats/min)	78.67 ± 5.75	78.5 ± 9.98	0.0350
8.	WH ratio	0.8466 ± 0.0989	0.8754 ± 0.0806	0.7113
9.	Head length (cm)	21.82 ± 3.19	19.75 ± 1.65	1.1784
10.	Head breadth (cm)	15.03 ± 1.00	14.65 ± 0.93	0.6046
11.	PEFR (L/min)	545 ± 27.39	40.5 ± 10	9.6394*
12.	Body Fat percentage	9.42 ± 3.74	23.48 ± 3.58	5.9134*
13.	Jump score (cm)	33.17 ± 9.26	22.5 ± 6.56	1.9795*
14.	PAPw (watt)	2277.32 ± 875.19	2040.08 ± 791.4	0.4351

BME → Basal Metabolic rate

PI → Ponderal index

BSA → Body surface area

BP → Blood pressure

WH ratio → Waist Hip ratio

PEFR → Pulse Expiratory flow rate

PAPw → Peak anaerobic power output



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Variables (unit)	Values in male (n=6)	Values in female (n=4)	t-score
1. Stature (cm)	163.50 ± 8.68	152.98 ± 7.24	1.9956 *
2. Weight (kg)	62 ± 16.7	63.25 ± 14.6	0.1220
3. BMI (kg/m <sup>2</sup> )	23.09 ± 5.27	26.76 ± 3.71	1.1990
4. PI (kg/m <sup>3</sup> )	14.15 ± 3.18	17.45 ± 1.72	1.8810 *
5. BSA (m <sup>2</sup> )	1.6622 ± 0.2201	1.6018 ± 0.2072	0.4345
6. BP (mm of Hg)	-	-	-
• Systolic	123.3 ± 10.71	117.5 ± 9.57	0.8730
• Diastolic	75.3 ± 6.02	79.5 ± 3.42	1.2510
7. Pulse rate (beats/min)	76 ± 5.52	78 ± 6.73	0.5160
8. WH ratio	0.9254 ± 0.0652	0.9140 ± 0.0388	0.3110
9. Head length (cm)	21.33 ± 2.12	21.65 ± 1.13	0.2661
10. Head breadth (cm)	14.83 ± 0.96	14.63 ± 0.59	0.3670
11. PEFK (l/min)	528.33 ± 53.07	402.50 ± 23.63	4.3920 *
12. Body fat percentage	13.53 ± 4.47	23.58 ± 5.60	11.68 *
13. Jump score (cm)	27.5 ± 6.28	13.75 ± 4.27	3.7935 *
14. PAPw (watt)	2422.85 ± 809.82	1644.85 ± 559.51	1.6600

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BMI → Body Mass index



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Variables (unit)	Values in male (n=6)	Values in female (n=9)	t-score
1. Stature (cm)	161.62 ± 1.29	153.7 ± 6.70	2.9384 *
2. Weight (kg)	62.08 ± 13.72	62.25 ± 2.87	0.4080
3. BMI (kg/m <sup>2</sup> )	23.71 ± 5.39	24.33 ± 6.25	0.1677
4. PI (kg/m <sup>3</sup> )	14.66 ± 3.37	17.30 ± 2.51	1.3295
5. BSA (m <sup>2</sup> )	1.4826 ± 0.2375	1.5998 ± 0.0603	0.9487
6. BP (mm of Hg)	-	-	-
• Systolic	134.67 ± 20.89	139 ± 27.2	6.8910
• Diastolic	85 ± 8.74	87.5 ± 15	0.3370
7. Pulse rate (beats/s)	77.50 ± 5.36	76.5 ± 8.06	0.2380
8. WH ratio	0.9036 ± 0.0684	0.9009 ± 0.0168	0.0760
9. Head length (cm)	22.18 ± 0.72	22.48 ± 0.97	0.5642
10. Head breadth (cm)	15.32 ± 0.99	14.58 ± 0.99	1.1525
11. PEFV (lt/min)	505 ± 32.71	360 ± 33.67	6.792 *
12. Body fat percentage	15.03 ± 3.40	26.55 ± 3.26	24.89 *
13. Jump score (cm)	27.5 ± 4.76	15.5 ± 3.70	2.4676 *
14. PAPw (watt)	2123.13 ± 782.70	1705.78 ± 271.48	1.009

BMI → Body Mass Index

PI → Ponderal index

BSA → Body Surface area

BP → Blood pressure

WH ratio → Waist Hip ratio

PEFR - Pulmonary Expiratory flow rate

PAPw - Peak anaerobic power output

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## Observation and Discussion

The average value of height of male subjects was significantly higher than that of the average value of female subjects in all the age groups. But surprisingly, the mean value was observed to decrease with age in male (not significantly) and also increased with age in female (not significantly). Although there was no significant difference between mean weight of male and female in either of the groups.

The average values of Body Mass Index (BMI) and PI (Ponderal Index) were found to be in normal range in males whereas in females ~~the~~ average value was higher than the normal range and indicated obesity in population. And, the comparison of sex groups showed that there was a significant difference (higher in female than male) in the age group of 21-30 years but in other age groups there was no such significant difference. The average value of body surface area (BSA) didn't vary significantly in any age groups between male and female.



The mean blood pressure (BP) of age group 21-30 years were slightly higher than normal in both males and females. The male samples had an higher average systolic blood pressure whereas the female samples had a higher average diastolic blood pressure. But, there was no such significant differences between the average blood pressure of two sexes. In the age group of 31-40 years, the mean blood pressure of both male and female are close to the normal range. The male samples had a higher average systolic blood pressure whereas the female subjects had a higher average diastolic blood pressure. But, there was no significant differences between the mean blood pressure in both sexes. In the age group of 41-50 years, the mean blood pressure in both male and female were much higher. It is a fact that blood pressure rises with age. Both systolic and diastolic blood pressure were found to be higher in females than in males.

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The average pulse rate (PR) for age group 21-30 years in age were slightly higher than the normal range of PR. The mean PR for both age groups 31-40, 41-50 years were found to be in normal range. None of age groups was found to significantly vary between male and females in PR values.

The average waist-hip ratio for all age groups and sex groups were found to be in normal range or very close to that of a normal person. And, there were no significant differences of waist-hip ratio in male and female.

The mean head lengths and head breadths in the age group of 21-30 years had significant differences between male and female. But, there was no significant differences between the data of male and female. It was also seen that the skull might keep growing till the age of 31-40 years.

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The values of pulmonary expiratory flow rate (PEFR) had significant differences between male and female. Males had higher PEFR than females in all age group. The values of PEFR of both sexes in the age group of 21-30 years of age were in the normal healthy range. But, the PEFR values in older age groups were slightly below normal in both male and female. It was found that irrespective of sex, there was no significant difference in PEFR values in older age groups.

The average percentage of body fat in males were within the ideal range in all age groups. In males, the composition of body fat also increased with age. Females had slightly higher fat content than recommended values in all age groups. There was a significant difference in body fat percentage between male and females irrespective of age groups.

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In males, the mean score of vertical jump in all age groups were slightly below normal but close. In case of females, irrespective of age groups, the mean score was significantly lower than the ideal range. Hence, in all age groups, there was a significant difference of mean score of vertical jump of males and females.

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