# Description of The Variables

- **The collected data contains the following Variables**

1. Name
2. Age
3. Gender
4. Height (Ht)
5. Weight (Wt)
6. Address (Senior citizen association name)
7. Medical History (Med History)
8. Surgical History (Sx History)
9. Medication
10. Hypertension (HTN)
11. Diabetes Mellitus (DM)
12. Blood pressure (B.P.)
13. Geriatric Depression (GDS)
14. Cognition scale (MoCA)
15. Lung function (PEFR)
16. Endurance test (2MWT)
17. Balance tested dynamically (TUG)
18. Balance tested statically (FRT)
19. Cognition (TMT A)
20. Higher level cognition (TMT B)
21. Quality of life (OPQOL)
22. Physical activity measurement (QPAR)
23. Body mass index (BMI)

- **Description of the Tests (Sr. Nos 13 to 21)**

13. Geriatric depression:

    This is assessed by the paper-based Geriatric Depression Scale, shortened to GDS. This is a 30-point scale, with Yes and No as the response options. There are 30 statements, which are scored as 0 or 1 based on the response given. The maximum score is 30, minimum is 0. Depression can be diagnosed if the patient scores 9 or higher on this scale. Higher the score, more is the depression. Scoring is as follows:

    a. 0 to 9 = Normal
    b. 10 to 19 = Mild depression
    c. 20 to 30 = Severe Depression

14. Lung function (PEFR):

    This is a physical test performed using a device known as the peak flow meter. The person inhales and places the device's mouthpiece in their mouth. They exhale as forcefully as they can. A small indicator on the device is pushed ahead with the force of this exhalation. This shows the amount of air that was forcefully pushed out by the person. The more the forceful air exhalation, the better is the lung capacity.

15. Endurance test (2MWT):

    This is a physical test performed by the individual. A specified distance is marked using two cones / markers. The individual walks between the two markers for a duration of 2 minutes. They are instructed to go as far as they can. The distance that they cover in the 2 minutes is measured. this is the actual distance that they walked. The predicted distance can be calculated using a formula. The percentage distance walked is calculated. If the person covers 75% and more of the predicted distance, the endurance is good.

16. Balance tested dynamically (TUG):

    The Timed Up and Go test is again a physically performed test. The test assesses the dynamic balance of the individual. The person sits on a chair without arms. A marker is placed at a distance of 3 meters from the chair. When the command "Go" is given, the person has to get up from the chair without using any hand support, walk towards the marker, turn around it, walk back towards the chair, turn around, and sit in the

chair. The time required to complete the test is noted. The normative values of time taken to complete the test are categorised by age. In general, the test should be completed between 7 to 10 seconds. The longer it takes to complete the test, the worse is the dynamic balance. This indicates that the person is at risk of falling, which can cause mild to severe injuries.

17. Balance tested statically (FRT):

    This is another physical test but assesses the static balance of a person. A tape measure is mounted on a wall at the height of the person's shoulder. The person stands next to the wall, ensuring that they are not touching / leaning against it. While maintaining their posture appropriately, they then reach forward as far as is possible. The distance that the person can reach forward for is measured. The more the distance covered by the person, the better is the static balance, and the lesser is the risk of fall.

18. Cognition (TMT A):

    This is a paper-based test, where the patient has to join a series of numbers from 1 to 25. The time taken to complete this is recorded in seconds. The lesser time required to complete this test, the better is the cognition of the individual.

19. Higher level cognition (TMT B):

    This is a higher-level modification of the TMT A. In this, the patient has to join numbers and alphabets alternately in sequence, Ex. 1-A-2-B-3-C-4-D-5-E … 12-L. In this test, the individual's ability to keep a separate track of the letter and number sequences is tested. This indicates the functioning of the brain, hence, tests cognition. Again, the lesser time to complete this test shows better functioning of the brain.

20. Quality of life (OPQOL):

    The quality of life of the individual is assessed using this test. It asks questions related the functioning and ease of functioning in activities that they carry out daily. The higher the score, higher is the quality of life.

21. Physical activity measurement (QPAR):

    The physical activity level of the individual is measured using this scale. It identifies how much the person is active.

# Description of The Dataset

| Sr. No. | Variable Name | Count | Null Count |
|---|---|---|---|
| 1 | Age | 833 | 0 |
| 2 | Gender | 833 | 0 |
| 3 | Ht | 833 | 0 |
| 4 | Wt | 833 | 0 |
| 5 | Address | 798 | 35 |
| 6 | Med History | 352 | 481 |
| 7 | Sx History | 450 | 383 |
| 8 | Medication | 342 | 491 |
| 9 | HTN | 583 | 250 |
| 10 | DM | 567 | 266 |
| 11 | B.P. | 720 | 113 |
| 12 | Systolic | 720 | 113 |
| 13 | Diastolic | 717 | 116 |
| 14 | GDS | 779 | 54 |
| 15 | MOCA | 781 | 52 |
| 16 | PEFR 2 | 489 | 344 |
| 17 | 2 MWT | 606 | 227 |
| 18 | TUG | 773 | 60 |
| 19 | FRT | 731 | 102 |
| 20 | TMT A | 532 | 301 |
| 21 | TMT B | 466 | 367 |
| 22 | OPQOL | 92 | 741 |
| 23 | QPAR | 93 | 740 |

The important study variables i.e. QPAR, OPQOL, TMT B, TMT A, PEFR 2, 2 MWT contains the large number of null values.

# Description of Important Variables

- GDS - Geriatric Depression Score

| GDS Score | GDS level | Count |
|---|---|---|
| 0 to 9 | Normal | 662 |
| 10 to 19 | Mild Depression | 103 |
| 20 to 30 | Severe Depression | 14 |

- MoCA - Montreal Cognitive Assessment Test

| MoCA Score | MoCA level | Count |
|---|---|---|
| 0 to 10 | Severe Cognitive Impairment | 21 |
| 10 to 17 | Moderate Cognitive Impairment | 48 |
| 18 to 25 | Mild Cognitive Impairment | 333 |
| 26 to 30 | Normal | 379 |

- QPAR - Quick Physical Activity Rating

| QPAR Score | QPAR level | Count |
|---|---|---|
| 0 to 19 | Less amount of Exercise | 24 |
| 20 to 42 | Moderate amount of Exercise | 51 |
| 43 and More | Large amount of Exercise | 14 |

- OPQOL - Older People Quality of Life

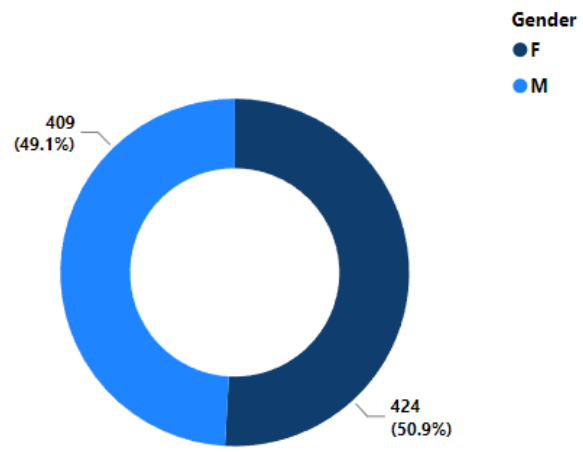
| OPQOL Score | OPQOL level |
|---|---|
| 35 | Lowest level |
| 175 | Highest level |

- BMI – Body Mass Index

| BMI Score | BMI Status | Count |
|---|---|---|
| Less than 18.5 | Underweight | 17 |
| 18.5 to 22.9 | Normal | 184 |
| 23 to 24.9 | Overweight | 169 |
| 25 and More | Obese | 463 |

# Exploratory Data Analysis

## ◉ Distribution of Male and Female Population

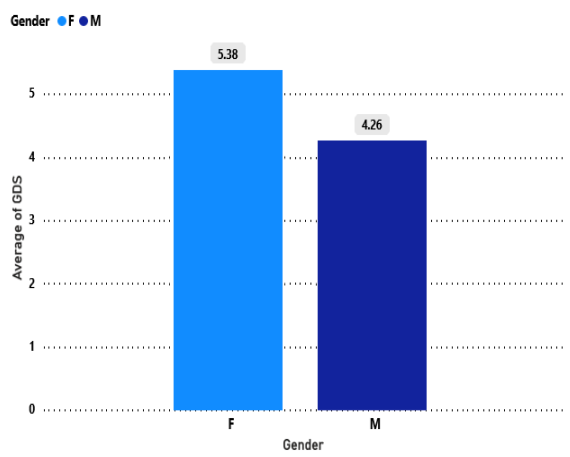



**Interpretation :**

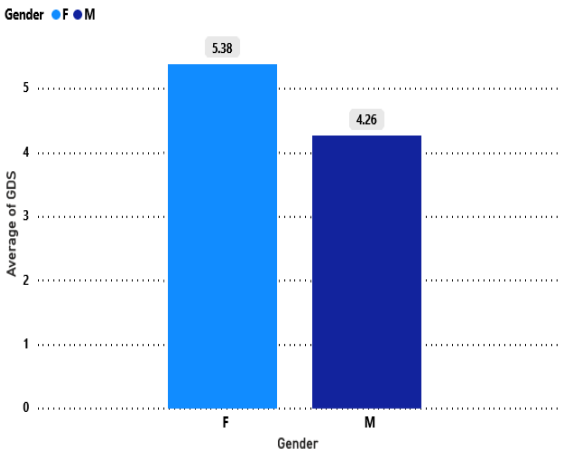
There is nearly equal number of Male and Female population in the data.

## Gender wise Performance in all Tests :

### 1. GDS



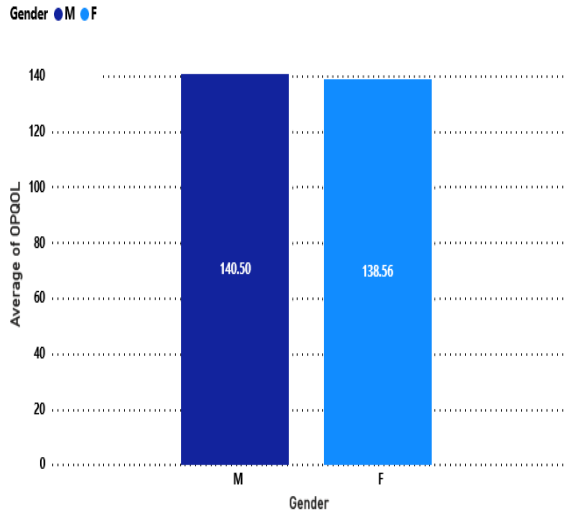

### 2. QPAR



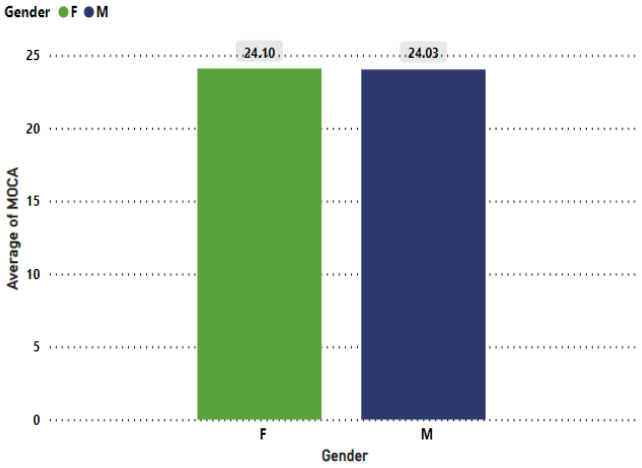

**Interpretation :**

- The average Geriatric Depression Score in Female population are slightly greater than the Male population.
- The average Quick Physical Activity Rate are better in Female population than the Male population.

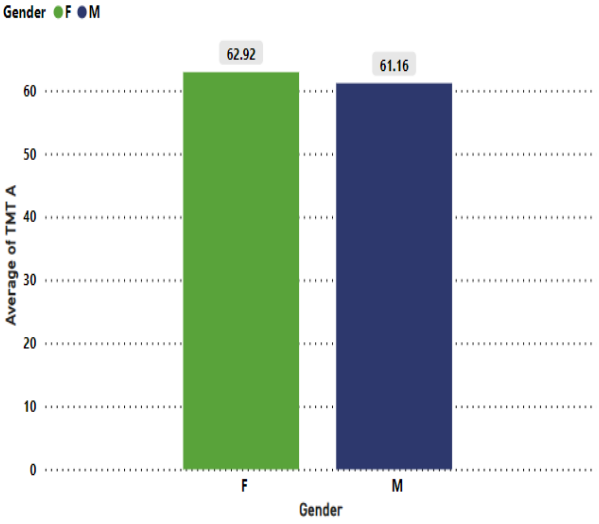
### 3. OPQAL



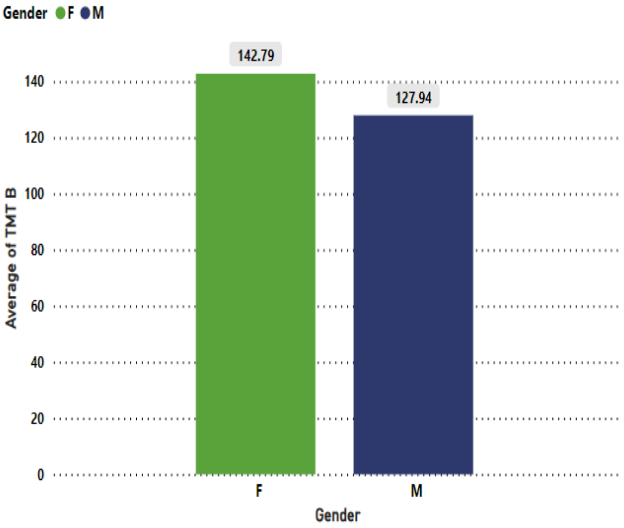

### 4. MOCA




### 5. TMT A



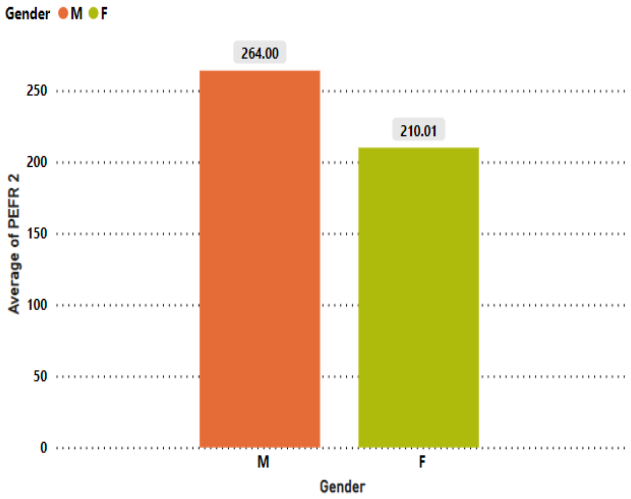

### 6. TMT B



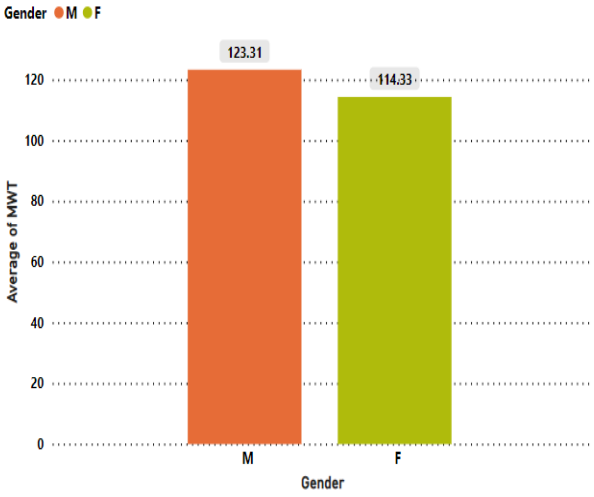

**Interpretation :**

- The average Older People Quality of Life scores are almost same for Male and Female population.
- The average Montreal Cognitive Assessment scores are almost same for Male and Female population.
- In Trail Making Test A & B, Male population performs better than the Female population.

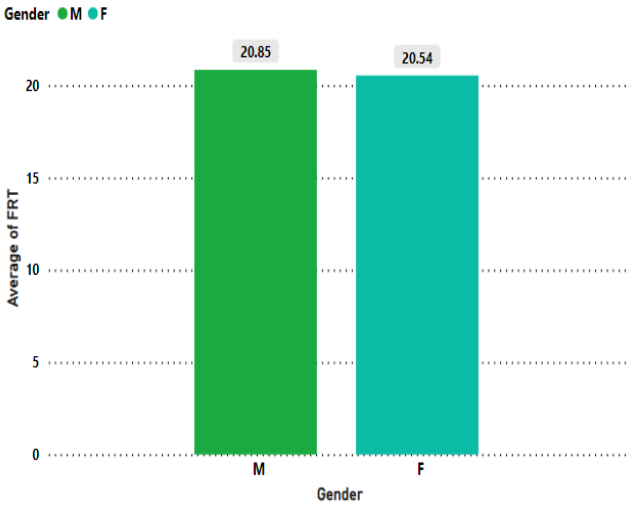
### 7. PEFR 2



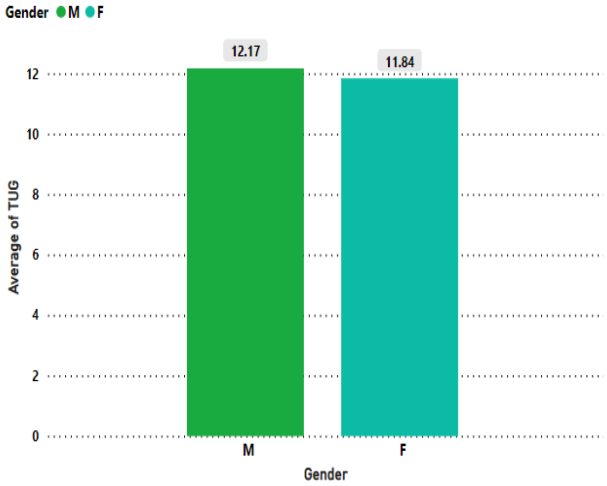

### 8. 2 MWT




### 9. FRT



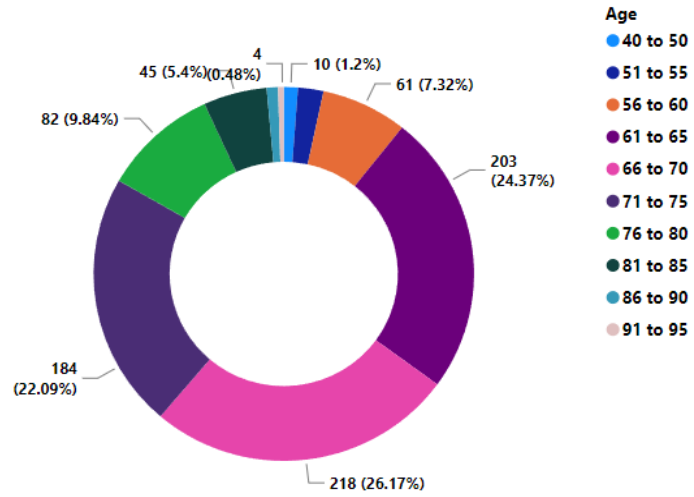

### 10. TUG




**Interpretation :**

- The average Peak Expiratory Flow Rate are higher in Male population than the Female population.
- The Two Minute Walk Test results are better in Male population than the Female population.
- The Functional Reach Test results are almost same for both Male population Female population.
- In Timed Up and Go Test, Male population performs better than the Female population.

## ◉ Distribution of Population Age wise

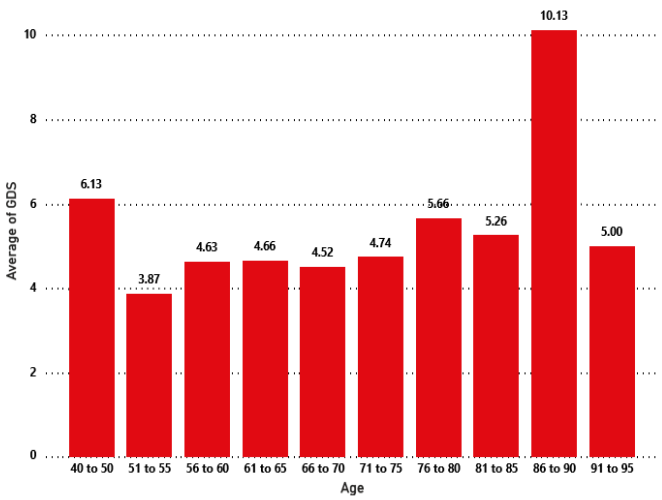



**Interpretation :**

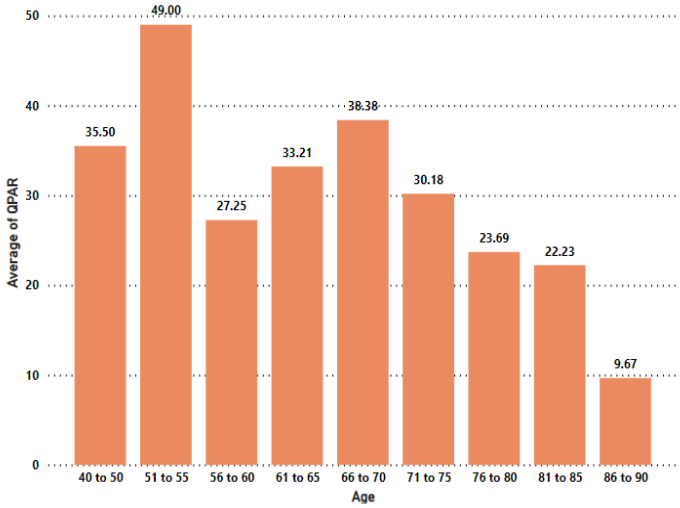
Near about 70% of the population belongs to age group 61 to 75.

## Age wise Performance in all Tests :

### 1. GDS




### 2. QPAR

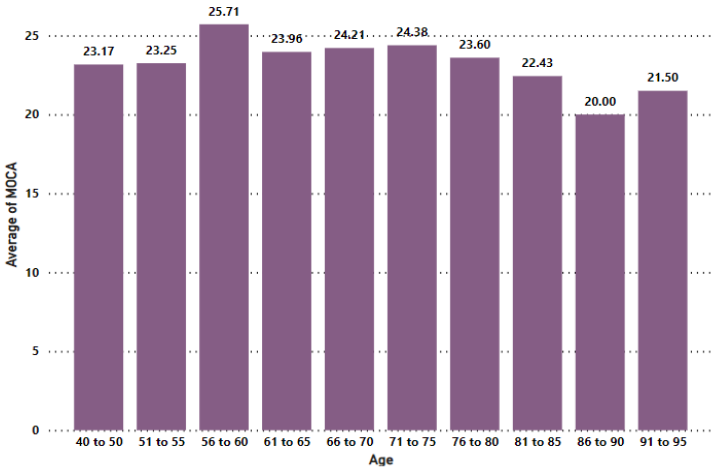



**Interpretation :**

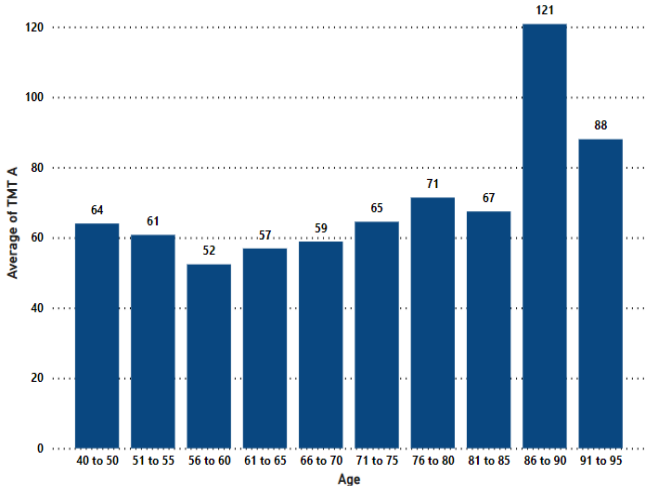
- The average Geriatric Depression Scores are increasing slightly with the increase in age of a person.
- The average Quick Physical Activity Scores are decreasing with the increase in age of a person.

### 3. OPQAL

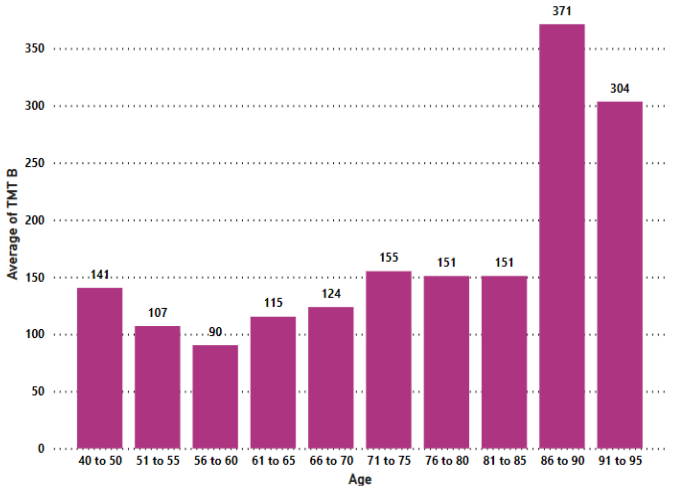

### 4. MOCA




### 5. TMT A



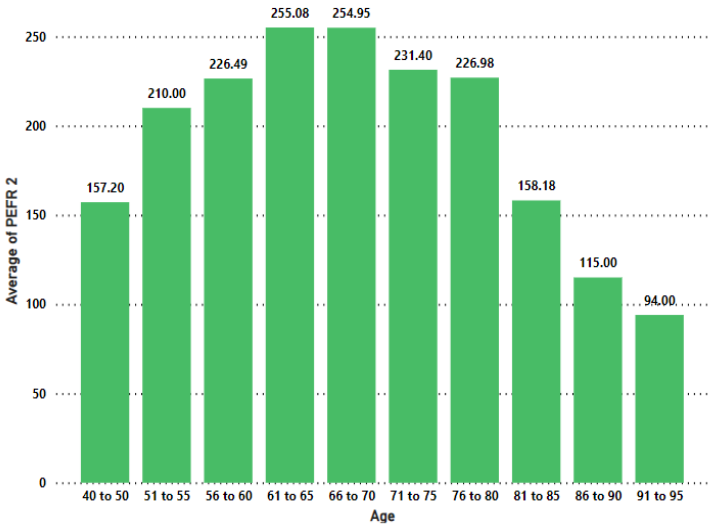

### 6. TMT B



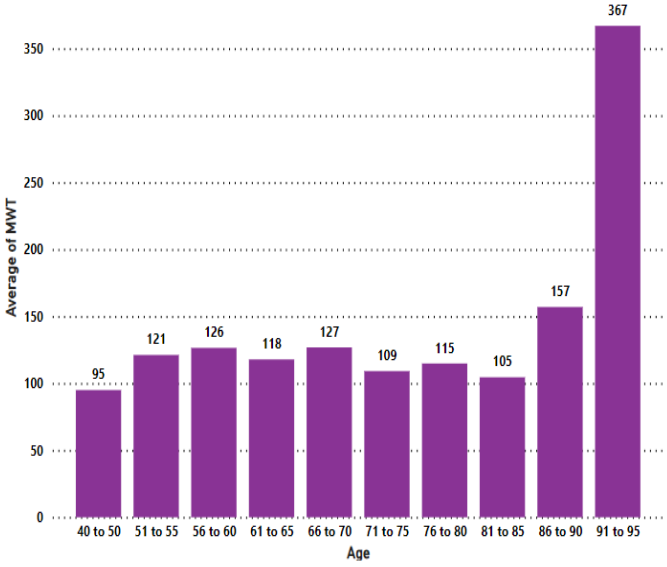

**Interpretation :**

- The average Older People Quality of Life of Older People decreases slightly with the increasing age.
- The average Montreal Cognitive Assessment scores are decreases slightly with the increasing age.
- In Trail Making Test A & B, the younger age population performs better than the old age population.

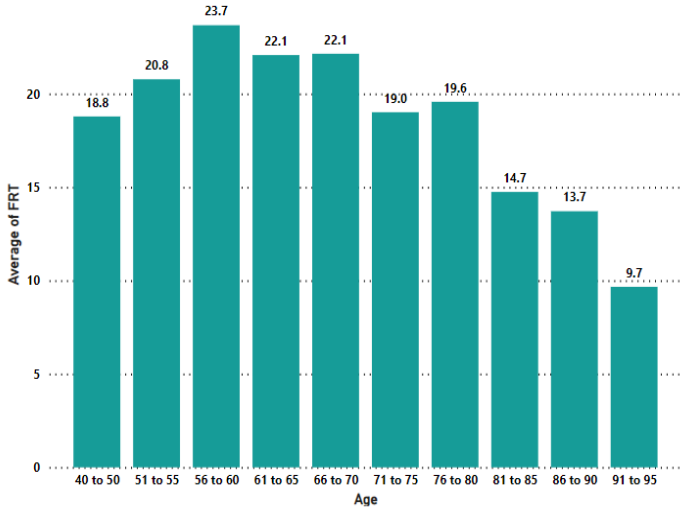
## 7. PEFR 2



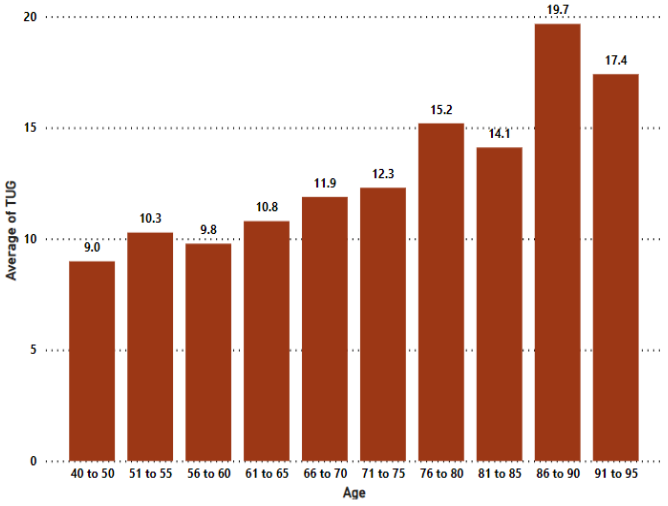

## 8. 2 MWT




## 9. FRT



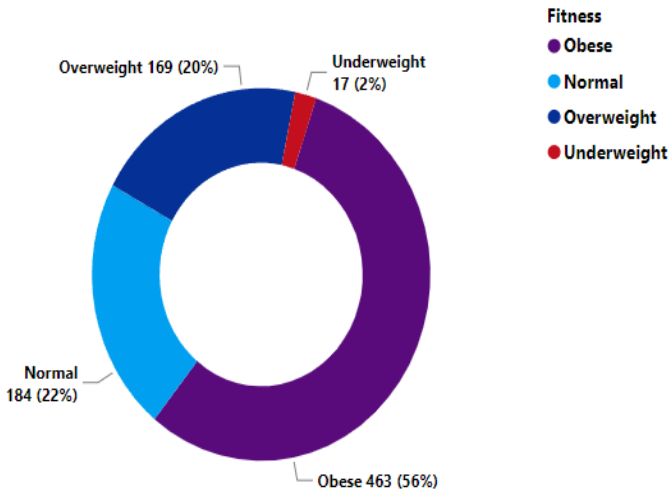

## 10. TUG




**Interpretation :**

- The average Peak Expiratory Flow Rate are higher in 56 to 80 age group.
- The Two Minute Walk Test results are almost same for all age group except 86 to 90 and 91 to 95.
- The Functional Reach Test results are decreases slightly with the increasing age.
- In Timed Up and Go Test, average time required to complete the test goes on increasing with the age.

## ◉ Distribution of Population according to their Physical Health

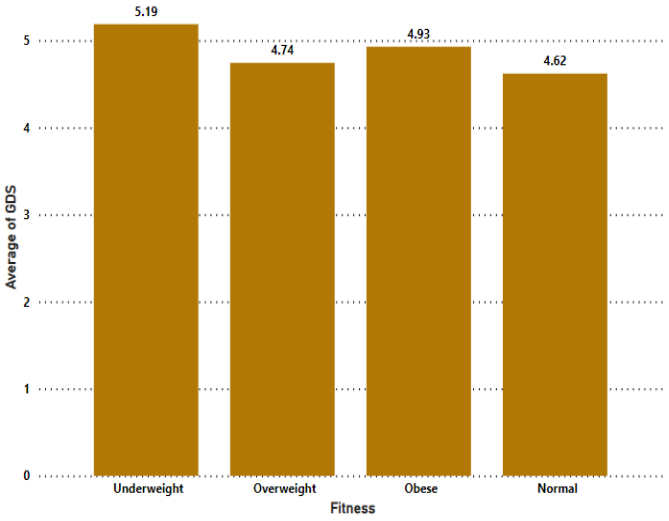



**Interpretation :**

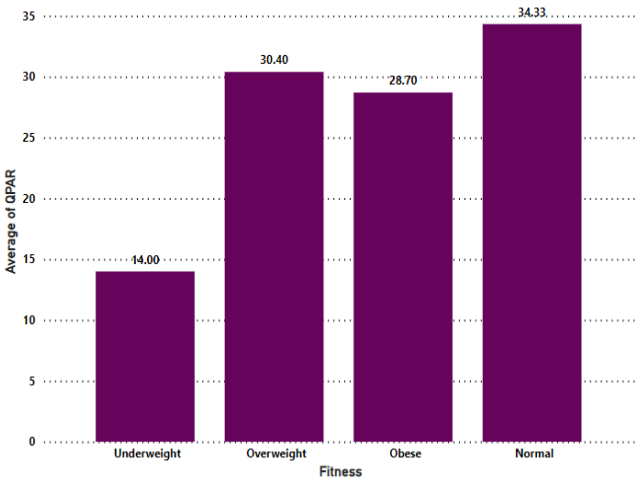
BMI score indicates that 56% of the population are Obese, 22% Normal, 20% Overweight and 2% Underweight.

## Fitness wise Performance in all Tests :

### 1. GDS



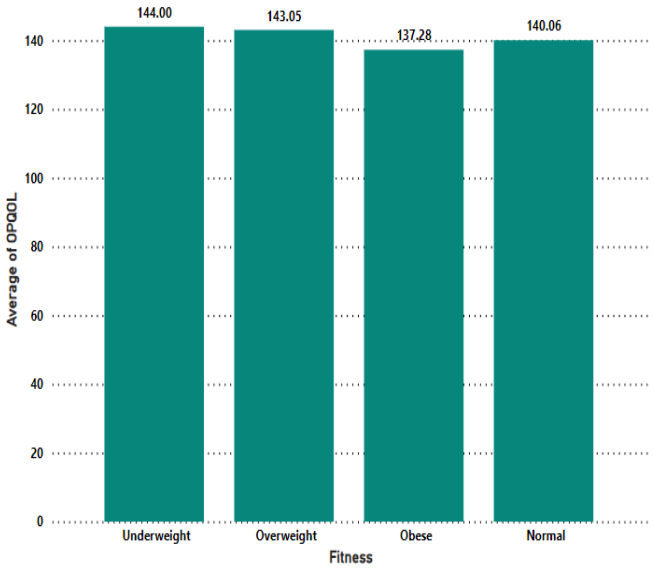

### 2. QPAR



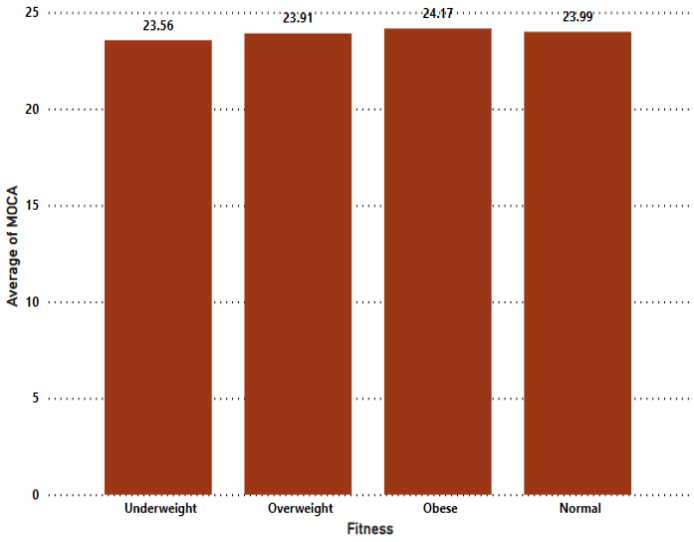

**Interpretation :**

- The Underweight population shows higher average GDS followed by Obese. Population with Normal fitness shows lowest average GDS of all.
- The average Physical Activity Rate is lowest in Underweight population followed by Obese population. Population with Normal fitness shows highest QPAR score.

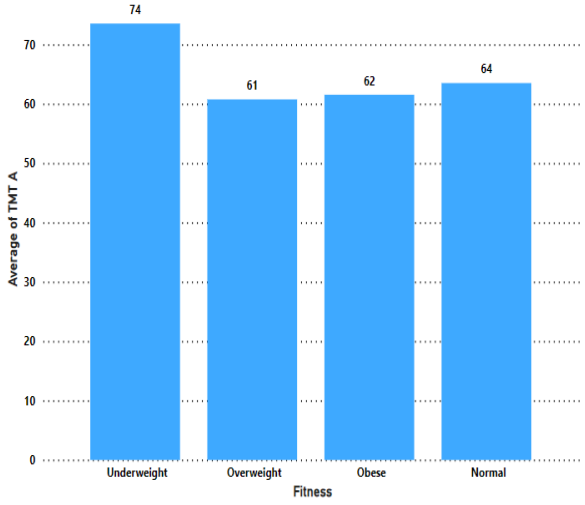
### 3. OPQAL



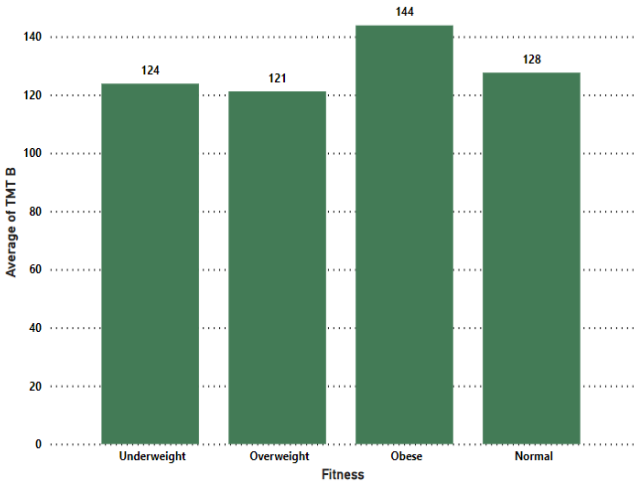

### 4. MOCA




### 5. TMT A



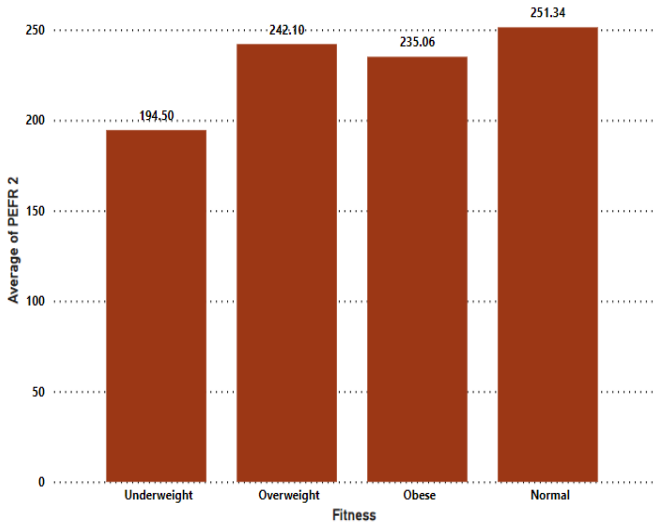

### 6. TMT B



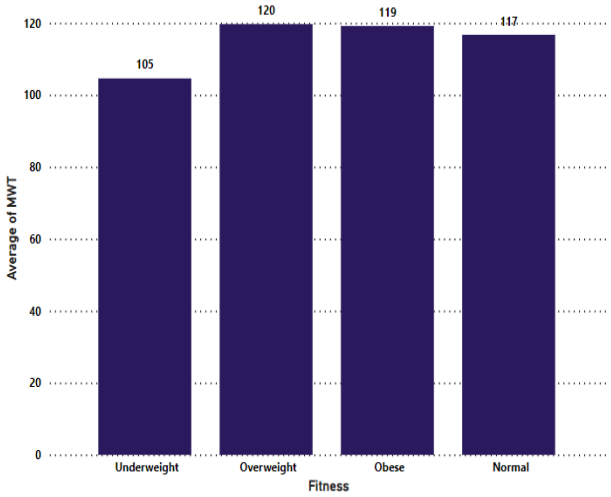

**Interpretation :**

- The average Older People Quality of Life of Older People somewhat lower for the Obese population.
- The average Montreal Cognitive Assessment scores are nearly same for all the Fitness group.
- In Trail Making Test A, The Underweight population not performing well.
- In Trail Making Test B, The Obese population not performing well.

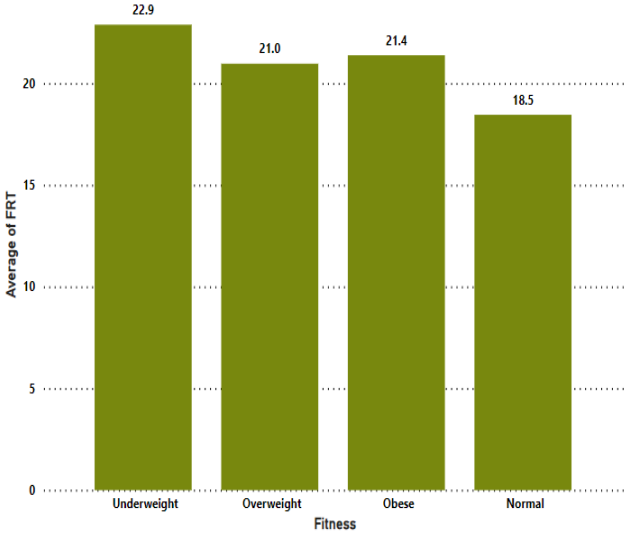
**7. PEFR 2**



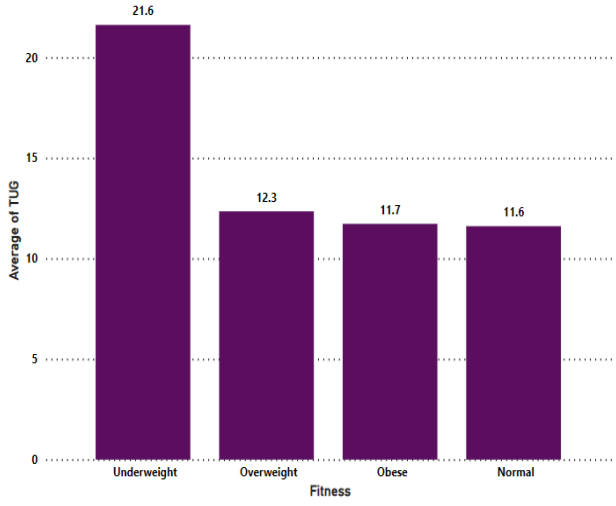

**8. 2 MWT**




**9. FRT**




**10. TUG**

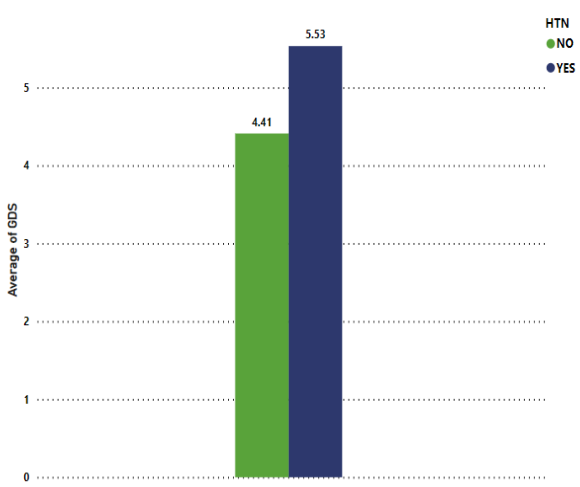



**Interpretation :**

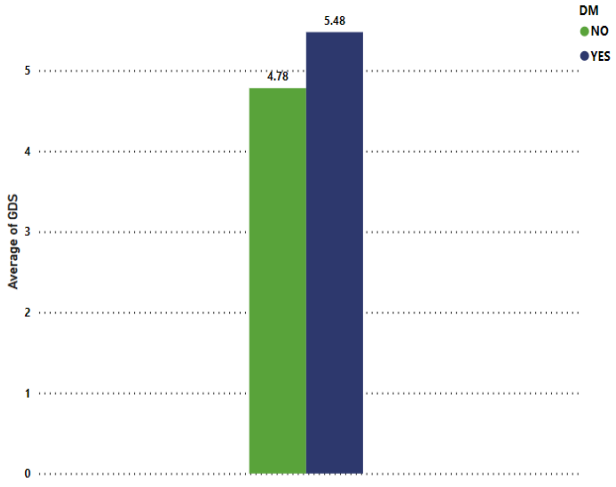
- The average Peak Expiratory Flow Rate are higher in Normal fitness group.
- The Two Minute Walk Test results are almost same for all fitness group except Underweight one.
- The Functional Reach Test results are better in Underweight population followed by Obese and Overweight population.
- In Timed Up and Go Test, average time required to complete the test is almost same for all fitness group except Underweight one.

## ◉ GDS Score Comparison for the Population with

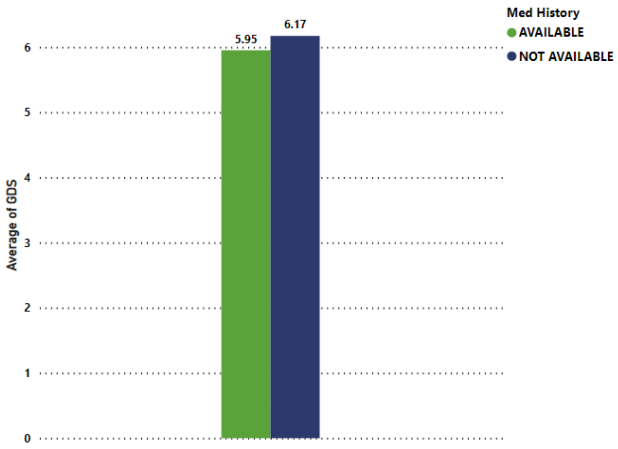
### (a) Hypertension (HTN)



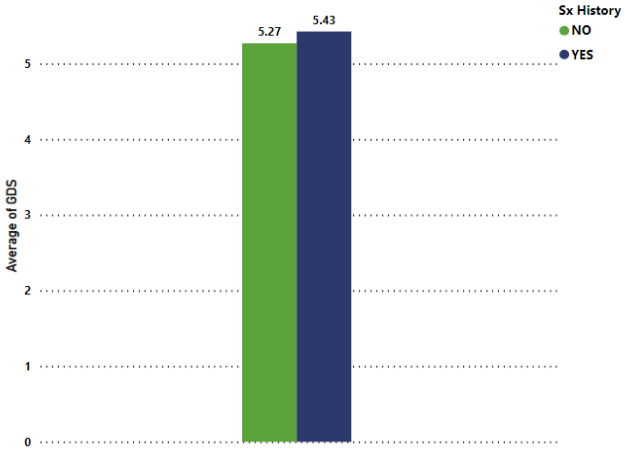

### (b) Diabetes Mellitus (DM)




### (c) Medical History




### (d) Surgical History

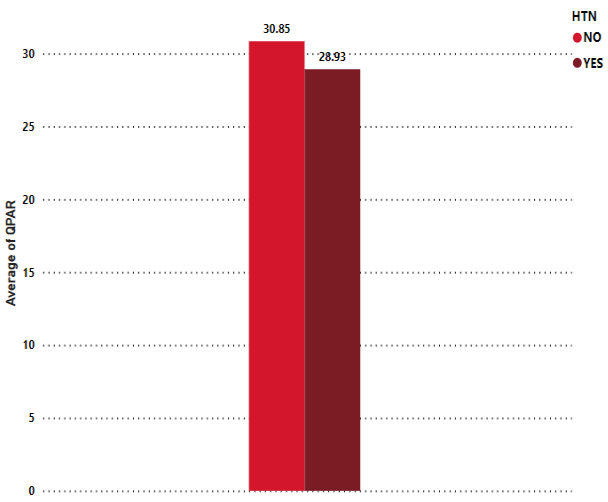



**Interpretation :**

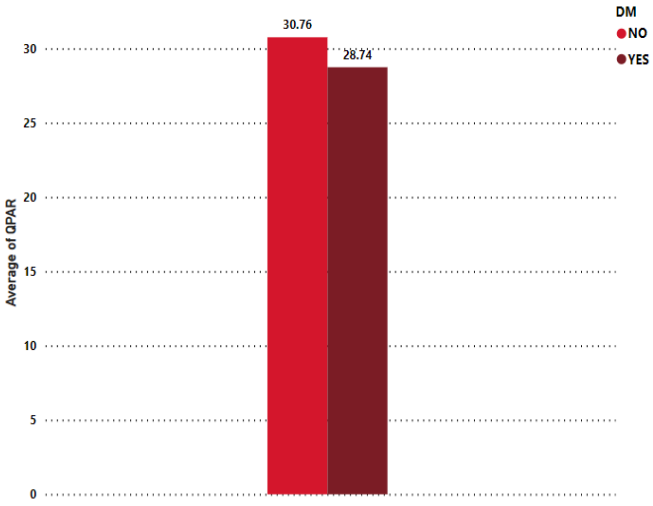
- The population having Hypertension (HTN) and Diabetes Mellitus (DM) have higher Geriatric Depression Score than the population not having HTN and DM.
- The population having some Medical history and Surgical history have higher Geriatric Depression Score.

## ◉ QPAR Score Comparison for the Population with :

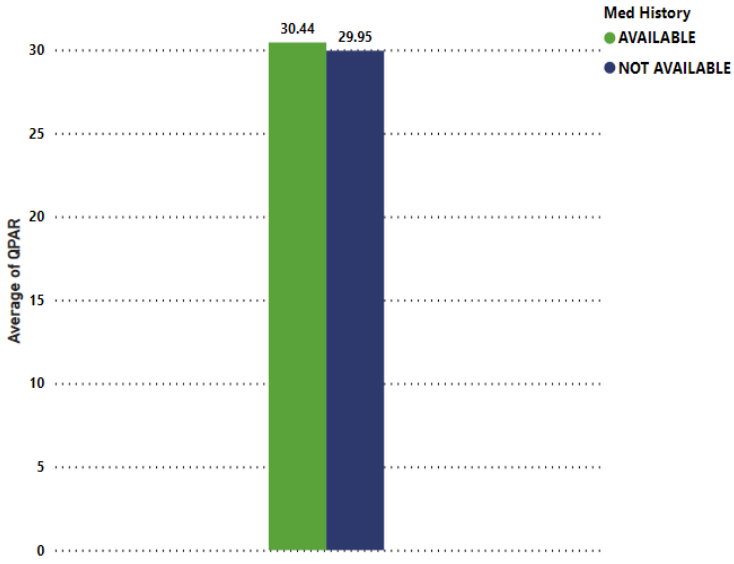
### (a) Hypertension (HTN)




### (b) Diabetes Mellitus (DM)




### (c) Medical History

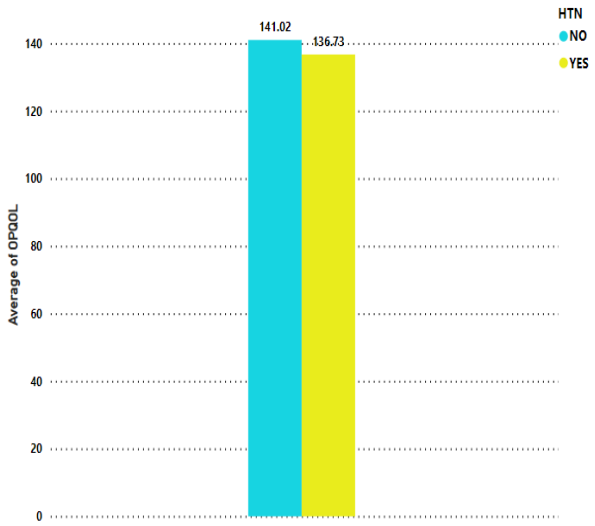



**Interpretation :**

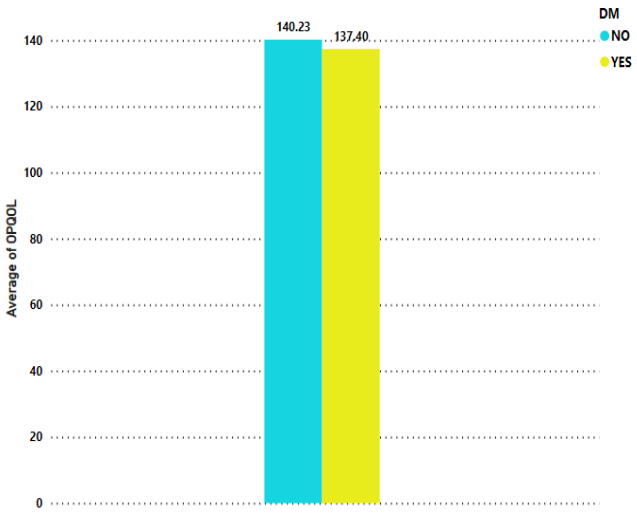
- The population not having Hypertension (HTN) and Diabetes Mellitus (DM) have higher Physical Activity Rate than the person having HTN and DM.
- The population having some Medical History have somewhat lower Quality of Physical Activity Rate.

## ◉ OPQAL Score Comparison for the Population with :

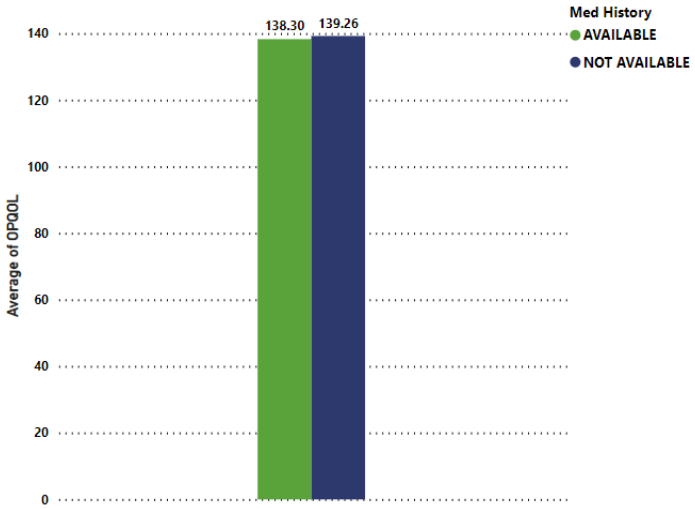
### (a) Hypertension (HTN)




### (b) Diabetes Mellitus (DM)




### (c) Medical History




**Interpretation :**

- The population not having Hypertension (HTN) and Diabetes Mellitus (DM) have higher Quality of Life score than the person having HTN and DM.
- The population having some Medical History have somewhat lower Quality of Life score.

# Correlation Testing

Correlation testing is a statistical method used to evaluate the strength and direction of the relationship between two or more variables. The correlation coefficient, which ranges from -1 to 1, is used to quantify this relationship. A correlation coefficient of 1 indicates a perfect positive correlation, meaning that as one variable increases, the other variable also increases. Conversely, a correlation coefficient of -1 indicates a perfect negative correlation, meaning that as one variable increases, the other variable decreases. A correlation coefficient of 0 indicates no linear correlation between the variables.

The objective of correlation testing is to determine whether there is a significant relationship between two variables, and if so, to quantify the strength of that relationship.

The test statistic in correlation testing is often the t-score, which is calculated using the formula :

$$t = \frac{r\sqrt{n-2}}{\sqrt{(1-r^2)}} \sim t_{n-2}$$

where,

r is the correlation coefficient

n is the sample size

The p-value is then calculated as the corresponding two-sided p-value for the t-distribution with n-2 degrees of freedom. If the p-value is less than the chosen significance level (often 0.05), we reject the null hypothesis of no correlation and conclude that there is a statistically significant correlation between the variables.

The assumptions of correlation testing includes :

1. **Linearity:** The relationship between the variables is linear.
2. **Independence:** The observations are independent of each other.
3. **Normality:** For **Pearson's correlation**, the variables should be approximately Normally distributed. Skewness of the variables can be used to check this assumption.

| Variable | Skewness | Variable | Skewness |
|---|---|---|---|
| GDS | 1.5751893618476618 | TMT B | 17.05048704780885 |
| OPQOL | -2.477009769889324 | PEFR | 0.35330874613700847 |
| QPAR | 0.8557763629487607 | TUG | 10.982342528908706 |
| MoCA | -2.110212166200407 | 2 MWT | 3.276112228197445 |
| TMT A | 2.1176491256673073 | FRT | 0.5964896234880194 |

## Spearman' rank correlation

Spearman's rank correlation measures the strength and direction of association between two ranked variables. It basically gives the measure of monotonicity of the relation between two variables i.e. how well the relationship between two variables could be represented using a monotonic function.

The formula for Spearman's rank coefficient is:

$$\rho = 1 - \frac{6\Sigma\, \mathrm{d}_i^2}{n(n^2 - 1)}$$

Where,

$\boldsymbol{\rho}$ = Spearman's rank correlation coefficient

di = Difference between the two ranks of each observation

n = Number of observations

The Spearman Rank Correlation can take a value from +1 to -1

1. Value of +1 means a perfect association of rank.
2. Value of 0 means there is no association between ranks.
3. Value of -1 means a perfect negative association of rank.

The assumptions of rank correlation testing includes :

1. Interval or Ratio level or ordinal data.
2. Unlike Pearson's correlation, there is no requirement of normality and hence it is a non-parametric statistics.

## Pearson's correlation

**Hypothesis to Test :**

H0 : There is no correlation between PEFR and FRT

H1 : There is correlation between PEFR and FRT

**R Code :**

```
cor.test(data1$pefr,data1$frt)
```

```
        Pearson's product-moment correlation
data:  data1$pefr and frt
t = -0.23748, df = 684, p-value = 0.1203
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.08387872  0.06582031
sample estimates:
       cor
0.07741478
```

**Decision & Conclusion**

As p-value > 0.05, H0 is Accepted.

There is no correlation between PEFR and FRT.

**• To test using Pearson's correlation**

1. Balance can have an effect on physical activity and physical functioning.
2. Physical activity levels can have an effect on depression.
3. Physical activity levels can have an effect on cognitive functioning.
4. Cognitive functioning can have an effect on depression.
5. Physical activity, cognitive functioning and depression can have an effect on quality of life.

## Spearman’s rank correlation

**Hypothesis to Test :**

H0 : There is no correlation between OPQOL and HTN

H1 : There is correlation between OPQOL and HTN

**R Code :**

```
cor.test(as.numeric(as.factor(data1$htn)),data$opqol, method = "spearman")
```

```
        Spearman's rank correlation rho
data:  as.numeric(as.factor(htn)) and opqol
S = 104908, p-value = 0.8197
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
-0.159454
```

**Decision & Conclusion**

As p-value > 0.05, H0 is Accepted.

There is no correlation between OPQOL and HTN

**• To test using Spearman’s rank correlation**

1. HTN, DM can have an effect on quality of life.
2. Surgeries, Medical history can have an effect on quality of life.

# Result Table

| Variables | p-value | cor / rho | Conclusion |
|---|---|---|---|
| PEFR and FRT | 0.1203 | 0.07741478 | No Correlation |
| 2 MWT and FRT | 2.2e-16 | 0.3543602 | Higher the 2 MWT score higher is the Balance. |
| TUG and FRT | 0.1606 | -0.0536241 | No Correlation |
| QPAR and GDS | 0.03836 | -0.2163087 | Lower The GDS score higher is the Quick Physical Activity Rate. |
| QPAR and MoCA | 0.0683 | 0.198702 | No Correlation |
| QPAR and TMT A | 0.02084 | -0.2503595 | Lower the TMT A score higher is the QPAR. |
| QPAR and TMT B | 0.002239 | -0.3329666 | Lower the TMT B score higher is the QPAR. |
| MOCA and GDS | 2.184e-07 | -0.1877575 | Lower the GDS score higher is the MOCA. |
| TMT A and GDS | 4.474e-05 | 0.1814684 | Higher the GDS score higher is the TMT A. |
| TMT B and GDS | 0.0002844 | 0.1747825 | Higher the GDS score higher is the TMT B. |
| OPQOL and GDS | 0.008454 | -0.274524 | Lower the GDS score higher is the quality of life. |
| OPQOL and MoCA | 0.04945867 | -0.05099649 | Lower the MoCA score indicates higher the quality of life. |
| OPQOL and TMT A | 0.371 | -0.09884821 | No Correlation |
| OPQOL and TMT B | 0.308 | 0.1146741 | No Correlation |
| OPQOL and QPAR | 0.001424 | 0.3313179 | Higher the QPAR value indicates higher quality of life |
| OPQOL and HTN | 0.8197 | -0.159454 | No Correlation |
| OPQOL and DM | 0.8732 | -0.01687207 | No Correlation |
| OPQOL and Med History | 0.4432 | -0.08092411 | No Correlation |
| OPQOL and Sx History | 0.1602 | -0.1476433 | No Correlation |

# MANN - WHITNEY U TEST

The Mann Whitney U test, sometimes called the Mann Whitney Wilcoxon Test or the Wilcoxon Rank Sum Test, is used to test whether two samples are likely to derive from the same population i.e., that the two populations have the same shape. It is used to compare the differences between two independent samples when the sample distributions are not normally distributed.

The Man-Whitney U Test is non – parametric counterpart to the t-test for independent samples. The t-test for independent of samples tests whether there is a mean difference. On the other hand Mann-Whitney U Test, Checks whether there is Rank Sum Difference. The advantage of taking Rank Sum rather than difference in Means is that the data need not to be Normally distributed.

**Assumption**

1. All of the observations from both groups are independent of each other. The responses are at least ordinal (i.e., one can at least say, of any two observations, which is the greater).
2. The shapes of the distributions for the two groups are roughly the same.

**Hypothesis to Test :**

H0 : The Two Population are Equal.

H1 : The Two Population are Not Equal.

**Test Statistics**

The test statistic for the Mann Whitney U Test is denoted **U** and is the smaller of $U_1$ and $U_2$, defined below.

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1 \qquad U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

Where,

$R_1$ = sum of the ranks for group 1, n1 = Number of observations from group 1

$R_2$ = sum of the ranks for group 2, n2 = Number of observations from group 2

**Decision & Conclusion**

Reject H0 at 100(1- α)% level of significance if U≤ U0 where U0 is found using statistical tables considering values of n1 and n2 and U is smaller than of U1 and U2.

OR Reject H0 at 100 (1-α) % level of significance if, p-value < 0.05

**• Why Mann - Whitney U Test ?**

1. To study the variables with respect to Gender.
2. To study the variables with respect Hypertension (HTN).
3. To study the variables with respect Diabetes Mellitus (DM).
4. To study the variables with respect Medical History.
5. To study the variables with respect Surgical History.

**1. Hypothesis to Test :**

H0 : Distribution of GDS score in Male and Female is same.

H1 : Distribution of GDS score in Male and Female is not same.

**R Code :**

```
wilcox.test(male_data$GDS, female_data$GDS)
```

Wilcoxon rank sum test with continuity correction

data: male_data$GDS and female_data$GDS
W = 63046, p-value = 4.173e-05
alternative hypothesis: true location shift is not equal to 0

**Decision & Conclusion**

As p-value < 0.05, H0 is Rejected.

Distribution of GDS score for Male population and Female is not same.

**Result Table**

| Variable | p-value | Conclusion |
|---|---|---|
| GDS | 4.173e-05 | GDS is not same for Male and Female population. |
| OPQOL | 0.1881 | OPQOL is same for Male and Female population. |
| QPAR | 0.7525 | QPAR is same for Male and Female population. |
| MoCA | 0.3018 | MoCA is same for Male and Female population. |
| TMT A | 0.6234 | TMT A is same for Male and Female population. |
| TMT B | 0.7537 | TMT B is same for Male and Female population. |
| PEFR | 1.054e-09 | PEFR is not same for Male and Female population. |
| TUG | 0.9649 | TUG is same for Male and Female population. |
| 2 MWT | 0.0586 | 2 MWT is same for Male and Female population. |
| FRT | 0.7444 | FRT is same for Male and Female population. |

**2. Hypothesis to Test :**

H0 : Distribution of GDS score with respect to Hypertension (HTN) is same.

H1 : Distribution of GDS score with respect to Hypertension (HTN) is not same.

**R Code :**

```
wilcox.test(hypertension_yes$GDS, hypertension_no$GDS)
```

Wilcoxon rank sum test with continuity correction

data: hypertension_yes$GDS and hypertension_no$GDS
W = 38783, p-value = 0.0551
alternative hypothesis: true location shift is not equal to 0

**Decision & Conclusion**

As p-value > 0.05, H0 is Accepted.

Distribution of GDS score with respect to Hypertension (HTN) is same.

**Result Table**

| Variable | p-value | Conclusion |
|---|---|---|
| GDS | 0.0551 | GDS score with respect to Hypertension (HTN) is same. |
| OPQOL | 0.1292 | OPQOL with respect to Hypertension (HTN) is same. |
| QPAR | 0.7626 | QPAR with respect to Hypertension (HTN) is same. |
| MoCA | 0.3482 | MoCA with respect to Hypertension (HTN) is same. |
| TMT A | 0.4686 | TMT A with respect to Hypertension (HTN) is same. |
| TMT B | 0.8205 | TMT B with respect to Hypertension (HTN) is same. |
| PEFR | 0.3852 | PEFR with respect to Hypertension (HTN) is same. |
| TUG | 0.002297 | TUG with respect to Hypertension (HTN) is not same. |
| 2 MWT | 0.003439 | 2MWT with respect to Hypertension (HTN) is not same. |
| FRT | 0.2058 | FRT with respect to Hypertension (HTN) is same. |

**3. Hypothesis to Test :**

H0 : Distribution of GDS score with respect to Diabetes Mellitus (DM) is same.

H1 : Distribution of GDS score with respect to Diabetes Mellitus(DM) is not same.

**R Code :**

```
wilcox.test(diabetes_yes$GDS, diabetes_no$GDS)
```

Wilcoxon rank sum test with continuity correction

data: diabetes_yes$GDS and diabetes_no$GDS
W = 35522, p-value = 0.2204
alternative hypothesis: true location shift is not equal to 0

**Decision & Conclusion**

As p-value > 0.05, H0 is Accepted.

Distribution of GDS score with respect to Diabetes Mellitus (DM) is same.

**Result Table**

| Variable | p-value | Conclusion |
|---|---|---|
| GDS | 0.2204 | GDS score with respect to DM is same. |
| OPQOL | 0.8753 | OPQOL with respect to Diabetes Mellitus (DM) is same. |
| QPAR | 0.2187 | QPAR with respect to Diabetes Mellitus (DM) is same. |
| MoCA | 0.1042 | MoCA with respect to Diabetes Mellitus (DM) is same. |
| TMT A | 0.08748 | TMT A with respect to Diabetes Mellitus (DM) is same. |
| TMT B | 0.0878 | TMT B with respect to Diabetes Mellitus (DM) is same. |
| PEFR | 0.4791 | PEFR with respect to Diabetes Mellitus (DM) is same. |
| TUG | 0.0002721 | TUG with respect to Diabetes Mellitus (DM) is not same. |
| 2 MWT | 0.07907 | 2 MWT with respect to Diabetes Mellitus (DM) is same. |
| FRT | 4.408e-05 | FRT with respect to Diabetes Mellitus (DM) is not same. |

**4. Hypothesis to Test :**

H0 : Distribution of GDS score with respect to Medical History is same.

H1 : Distribution of GDS score with respect to Medical History is not same.

**R Code :**

```
wilcox.test(med_yes$GDS,med_no$GDS)
```

Wilcoxon rank sum test with continuity correction

data: med_yes$GDS and med_no$GDS

W = 26300, p-value = 0.3152

alternative hypothesis: true location shift is not equal to 0

**Decision & Conclusion**

As p-value > 0.05, H0 is Accepted.

Distribution of GDS score with respect to Medical History is same.

**Result Table**

| Variable | p-value | Conclusion |
|---|---|---|
| GDS | 0.3152 | GDS score with respect to Medical History is same. |
| OPQOL | 0.5924 | OPQOL with respect to Medical History is same. |
| QPAR | 0.5782 | QPAR with respect to Medical History is same. |
| MoCA | 0.4644 | MoCA with respect to Medical History is same. |
| TMT A | 0.469 | TMT A with respect to Medical History is same. |
| TMT B | 0.02302 | TMT B with respect to Medical History is not same. |
| PEFR | 5.081e-11 | PEFR with respect to Medical History is not same. |
| TUG | 0.269 | TUG with respect to Medical History is same. |
| 2 MWT | 0.02875 | 2 MWT with respect to Medical History is not same. |
| FRT | 1.975e-08 | FRT with respect to Medical History is not same. |

**5. Hypothesis to Test :**

H0 : Distribution of GDS score with respect to Surgical History is same.

H1 : Distribution of GDS score with respect to Surgical History is not same.

**R Code :**

```
wilcox.test(sx_yes$GDS,sx_no$GDS)
```

Wilcoxon rank sum test with continuity correction

data: sx_yes$GDS and sx_no$GDS
W = 13376, p-value = 0.001914
alternative hypothesis: true location shift is not equal to 0

**Decision & Conclusion**

As p-value < 0.05, H0 is Rejected.

Distribution of GDS score with respect to Surgical History is not same.

**Result Table**

| Variable | p-value | Conclusion |
|---|---|---|
| GDS | 0.001914 | GDS score with respect to Surgical History is not same. |
| OPQOL | - | Insufficient data |
| QPAR | - | Insufficient data |
| MoCA | 0.09852 | MoCA with respect to Surgical History is same. |
| TMT A | 0.3995 | TMT A with respect to Surgical History is same. |
| TMT B | 0.005051 | TMT B with respect to Surgical History is not same. |
| PEFR | 0.9026 | PEFR with respect to Surgical History is same. |
| TUG | 0.5525 | TUG with respect to Surgical History is same. |
| 2 MWT | 1.985e-06 | 2 MWT with respect to Surgical History is not same. |
| FRT | 1.684e-06 | FRT with respect to Surgical History is not same. |

# Analysis of Variance (ANOVA) and Post hoc Test

ANOVA is a statistical method used to test differences between two or more means. It is like the t-test, but while the t-test is generally used for comparing two means, ANOVA is used when you have more than two means to compare.

**Objective**

The objective of ANOVA is to determine if there are significant differences among the group means. If the between group variance is high and the within group variance is low, this provides evidence that the means of the groups are significantly different.

**Test Statistic**

The test statistic in ANOVA is the F-ratio, which is the ratio of the between group variance to the within-group variance. If the between-group variance is significantly larger than the within-group variance, the F-ratio will be large and likely significant.

**Assumptions**

1. Independence: The observations are independent of each other.
2. Normality: The data within each group are normally distributed.
3. Homogeneity of variance: The variance of data in the groups should be the same.

**• To Study using Analysis of Variance (ANOVA) and Post hoc Test ?**

1. To study the variables with respect to different Age Group.
2. To study the variables with respect to different Physical Fitness.

## Post Hoc Test

Post hoc test is used only after we find a statistically significant result and need to determine where our differences truly came from. The term “post hoc” comes from the Latin for “after the event”.

Post hoc tests are an integral part of ANOVA. When you use ANOVA to test the equality of at least three group means, statistically significant results indicate that not all of the group means are equal. However, ANOVA results do not identify which particular differences between pairs of means are significant. Post hoc test identifies these differences between pairs of means that are significantly different.

**Test Statistic**

$$t = \frac{\bar{d}}{s_d/\sqrt{n}} \sim t_{n-1}$$

Where,

d - Mean of the differences between all pairs

sd - Standard deviation of the differences

n - Number of pairs

**Assumptions**

1. The participants should be selected randomly from the population.
2. The differences between the pairs should be approximately normally distributed.
3. There should be no extreme outliers in the differences.

## 1. Comparison of Geriatric Depression Score (GDS) for different Age Group

Response Variable : GDS

Treatments : Different Age Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average GDS between different Age groups.

H1 : There is a significant difference in the average GDS between different Age groups.

**ANOVA Table**

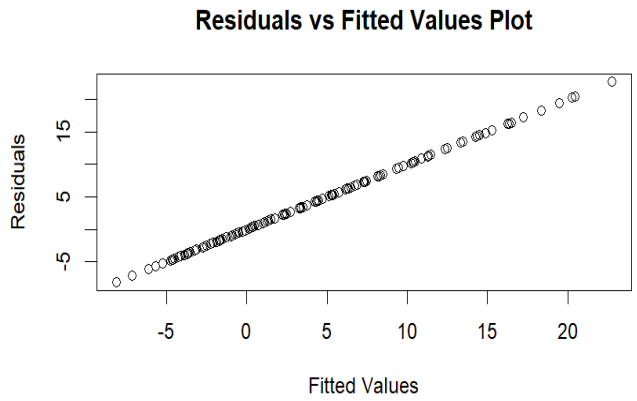
| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatments | 9 | 343 | 38.09 | 1.579 | 0.117 |
| Residuals | 769 | 18549 | 24.12 | | |

**Decision & Conclusion**

As, p-value > 0.05, H0 is Accepted.

There is no significant difference in the average GDS between people of different Age groups.

## Residual Plot




**Interpretation :**

The straight line indicates the residuals are normally distributed. i.e. Assumption is satisfied.

**Constant Variance**

H0 : All population variances are equal.

H1 : At least two population variances are different.

**R Code :**

```
bartlett.test(gds ~ Column, data = df)
```

Bartlett test of homogeneity of variances

data: gds by Column
Bartlett's K-squared = 15.394, df = 9, p-value = 0.08066

**Decision & Conclusion**

As p-value > 0.05, H0 is Accepted.

All population variances are equal. i.e. Assumption is satisfied.

**Hypothesis to Test :**

H0: Average GDS between two different Age Groups is same.

H1: Average GDS between two different Age Groups is not same.

**Post hoc Table**

| | 40 to 50 | 51 to 55 | 56 to 60 | 61 to 65 | 66 to 70 | 71 to 75 | 76 to 80 | 81 to 85 | 86 to 9 |
|---|---|---|---|---|---|---|---|---|---|
| 51 to 55 | 0.2939 | - | - | - | - | - | - | - | - |
| 56 to 60 | 0.4193 | 0.5955 | - | - | - | - | - | - | - |
| 61 to 65 | 0.4086 | 0.5472 | 0.9629 | - | - | - | - | - | - |
| 66 to 70 | 0.3635 | 0.6221 | 0.8823 | 0.771 | - | - | - | - | - |
| 71 to 75 | 0.4356 | 0.5086 | 0.8785 | 0.8753 | 0.6571 | - | - | - | - |
| 76 to 80 | 0.7979 | 0.1957 | 0.2288 | 0.1289 | 0.0802 | 0.1675 | - | - | - |
| 81 to 85 | 0.6459 | 0.3459 | 0.5266 | 0.4723 | 0.3698 | 0.537 | 0.6656 | - | - |
| 86 to 90 | 0.1037 | **0.0037** | **0.0031** | **0.0021** | **0.0016** | **0.0025** | **0.0145** | **0.0102** | - |
| 91 to 95 | 0.7721 | 0.7593 | 0.9155 | 0.9224 | 0.8895 | 0.9407 | 0.8516 | 0.9426 | 0.1873 |

**Interpretation :**

There is significant difference in GDS for people in 86 to 90 Age group.

**2. <u>Comparison of MOCA for different Age Group</u>**

Response Variable: MOCA

Treatments: Different Age Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average MOCA between different Age groups.

H1 : There is a significant difference in the average MOCA between different Age groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatments | 9 | 455 | 50.57 | 1.932 | 0.0447* |
| Residuals | 771 | 20188 | 26.18 | | |

**Decision & Conclusion**

As p - value < 0.05, H0 is Rejected.

The average MOCA between people of different Age Groups differ Significantly.

**Hypothesis to Test :**

H0 : Average MOCA between two different Age Groups is same.

H1 : Average MOCA between two different Age Groups is not same.

**<u>Post hoc Table</u>**

| | 40 to 50 | 51 to 55 | 56 to 60 | 61 to 65 | 66 to 70 | 71 to 75 | 76 to 80 | 81 to 85 | 86 to 90 |
|---|---|---|---|---|---|---|---|---|---|
| 51 to 55 | 0.9729 | - | - | - | - | - | - | - | - |
| 56 to 60 | 0.2468 | 0.0897 | - | - | - | - | - | - | - |
| 61 to 65 | 0.7073 | 0.5922 | **0.0246** | - | - | - | - | - | - |
| 66 to 70 | 0.6224 | 0.4698 | 0.0518 | 0.631 | - | - | - | - | - |
| 71 to 75 | 0.5667 | 0.3961 | 0.0904 | 0.4304 | 0.7416 | - | - | - | - |
| 76 to 80 | 0.8426 | 0.8049 | **0.0187** | 0.5959 | 0.3704 | 0.2604 | - | - | - |
| 81 to 85 | 0.7415 | 0.5841 | **0.0015** | 0.0737 | **0.0368** | **0.0238** | 0.2284 | - | - |
| 86 to 90 | 0.2663 | 0.1614 | **0.0055** | **0.0445** | **0.0326** | **0.0265** | 0.0753 | 0.2432 | - |
| 91 to 95 | 0.6901 | 0.6485 | 0.2528 | 0.4984 | 0.4562 | 0.4282 | 0.5673 | 0.8012 | 0.7148 |

**Interpretation :**

There is significant difference in MOCA for people in Age groups of following pairs :

1) 86 to 90 with 56 to 60, 61 to 65, 66 to 70 and 71 to 75
2) 81 to 85 with 56 to 60, 66 to 70 and 71 to 75
3) 76 to 80 with 56 to 60
4) 61 to 65 with 56 to 60

**3. <u>Comparison of QPAR for different Age Group</u>**

Response Variable : QPAR

Treatments : Different Age Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average QPAR between different Age groups.

H1 : There is a significant difference in the average QPAR between different Age groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatments | 8 | 4614 | 576.8 | 3.009 | 0.0051** |
| Residuals | 84 | 16100 | 191.7 | | |

**Decision & Conclusion**

As p - value < 0.01, H0 is Rejected.

The average QPAR between people of different Age groups differ highly Significantly.

**The data is insufficient to perform Post Hoc Analysis.**

**4. <u>Comparison of OPQOL for different Age Group</u>**

Response Variable : OPQOL

Treatments : Different Age Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average OPQOL between different Age groups.

H1: There is a significant difference in the average OPQOL between different Age groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatments | 8 | 4106 | 513.3 | 1.16 | 0.333 |
| Residuals | 83 | 36727 | 442.5 | | |

**Decision & Conclusion**

As p - value > 0.05, H0 is Accepted.

There is no significant difference in the average OPQOL between people of different Age groups.

**The data is insufficient to perform Post Hoc Analysis.**

**5. <u>Comparison of TMT A for different Age Group</u>**

Response Variable : TMT A

Treatments : Different Age Group

**Hypothesis to Test:**

H0: There is no significant difference in the average TMT A between different Age groups.

H1: There is a significant difference in the average TMT A between different Age groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatments | 8 | 4614 | 576.8 | 3.009 | 0.0051** |
| Residuals | 84 | 16100 | 191.7 | | |

**Decision & Conclusion**

As p - value < 0.01, H0 is Rejected.

The average TMT A between people of different Age Groups differ highly Significantly.

**Hypothesis to Test**

H0: Average TMT A between two different Age Groups is same.

H1: Average TMT A between two different Age Groups is not same.

| | 40 to 50 | 51 to 55 | 56 to 60 | 61 to 65 | 66 to 70 | 71 to 75 | 76 to 80 | 81 to 85 | 86 to 90 |
|---|---|---|---|---|---|---|---|---|---|
| 51 to 55 | 0.85606 | - | - | - | - | - | - | - | - |
| 56 to 60 | 0.46081 | 0.46025 | - | - | - | - | - | - | - |
| 61 to 65 | 0.63845 | 0.71119 | 0.46636 | - | - | - | - | - | - |
| 66 to 70 | 0.73328 | 0.85486 | 0.28996 | 0.63587 | - | - | - | - | - |
| 71 to 75 | 0.97354 | 0.71989 | 0.05163 | 0.07574 | 0.17425 | - | - | - | - |
| 76 to 80 | 0.63114 | 0.32743 | **0.00613** | **0.00578** | **0.01483** | 0.18793 | - | - | - |
| 81 to 85 | 0.82757 | 0.5581 | 0.05214 | 0.09422 | 0.16718 | 0.64025 | 0.57073 | - | - |
| 86 to 90 | **0.00682** | **0.00082** | **1.70E-05** | **2.70E-05** | **4.50E-05** | **0.00021** | **0.00141** | **0.00077** | - |
| 91 to 95 | 0.38601 | 0.28438 | 0.13833 | 0.18772 | 0.21662 | 0.31929 | 0.48501 | 0.39238 | 0.23627 |

**Interpretation :** There is significant difference in TMT A for people in 76 to 80 and 86 to 90 Age group.

**6. <u>Comparison of TMT B of different Age Group</u>**

Response Variable: TMT B

Treatments: Different Age Group

**Hypothesis to Test :**

H0: There is no significant difference in the average TMT B between different Age groups.

H1: There is a significant difference in the average TMT B between different Age groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatments | 9 | 520761 | 57862 | 1.343 | 0.212 |
| Residuals | 444 | 19128320 | 43082 | | |

**Decision & Conclusion**

As p - value > 0.05, H0 is Accepted.

There is no significant difference in the average TMT B between people in different groups.

**Hypothesis to Test :**

H0 : Average TMT B between two different Age Groups is same.

H1 : Average TMT B between two different Age Groups is not same.

| | 40 to 50 | 51 to 55 | 56 to 60 | 61 to 65 | 66 to 70 | 71 to 75 | 76 to 80 | 81 to 85 | 86 to 90 |
|---|---|---|---|---|---|---|---|---|---|
| 51 to 55 | 0.7858 | - | - | - | - | - | - | - | - |
| 56 to 60 | 0.6496 | 0.8246 | - | - | - | - | - | - | - |
| 61 to 65 | 0.8118 | 0.9057 | 0.5611 | - | - | - | - | - | - |
| 66 to 70 | 0.8736 | 0.8082 | 0.4262 | 0.7666 | - | - | - | - | - |
| 71 to 75 | 0.8905 | 0.4857 | 0.1287 | 0.1759 | 0.2619 | - | - | - | - |
| 76 to 80 | 0.9234 | 0.5401 | 0.1951 | 0.3104 | 0.4229 | 0.9029 | - | - | - |
| 81 to 85 | 0.9255 | 0.5672 | 0.264 | 0.4243 | 0.5333 | 0.9245 | 0.9995 | - | - |
| 86 to 90 | 0.0982 | **0.0206** | **0.0052** | **0.0074** | **0.0093** | **0.0235** | **0.0235** | **0.0293** | - |
| 91 to 95 | 0.365 | 0.2225 | 0.16 | 0.2049 | 0.225 | 0.3171 | 0.3075 | 0.3156 | 0.6968 |

**Interpretation :** There is significant difference in TMT B for people in 86 to 90 Age group.

**7. <u>Comparison of 2 MWT of different Age Group</u>**

Response Variable: MWT

Treatments: Different Age Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average TMT B between different Age groups.

H1 : There is a significant difference in the average TMT B between different Age groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 9 | 100302 | 11145 | 4.52 | 9.05e-06 *** |
| Residuals | 596 | 1469527 | 2466 | | |

**Decision & Conclusion**

As p - value < 0.01, H0 is Rejected.

The average MWT between people of different Age groups differ highly Significantly.

**Hypothesis to Test :**

H0 : Average MWT between two different Age Groups is same.

H1 : Average MWT between two different Age Groups is not same.

**The data is insufficient to perform Post Hoc Analysis.**

**8. <u>Comparison of FRT of different Age Group</u>**

Response Variable: FRT

Treatments: Different Age Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average FRT between different Age groups.

H1 : There is a significant difference in the average FRT between different Age groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 9 | 3829 | 425.4 | 3.169 | 0.000917 *** |
| Residuals | 715 | 95994 | 134.3 | | |

**Decision & Conclusion**

As p - value < 0.01, H0 is Rejected.

The average FRT between people of different Age groups differ highly Significantly.

**Hypothesis to Test :**

H0 : Average FRT between two different Age Groups is same.

H1 : Average FRT between two different Age Groups is not same.

| | 40 to 50 | 51 to 55 | 56 to 60 | 61 to 65 | 66 to 70 | 71 to 75 | 76 to 80 | 81 to 85 | 86 to 90 |
|---|---|---|---|---|---|---|---|---|---|
| 51 to 55 | 0.68382 | - | - | - | - | - | - | - | - |
| 56 to 60 | 0.24333 | 0.39435 | - | - | - | - | - | - | - |
| 61 to 65 | 0.40675 | 0.67749 | 0.38267 | - | - | - | - | - | - |
| 66 to 70 | 0.39585 | 0.65999 | 0.40018 | 0.95333 | - | - | - | - | - |
| 71 to 75 | 0.9545 | 0.57288 | **0.01187** | **0.01551** | **0.01171** | - | - | - | - |
| 76 to 80 | 0.84775 | 0.71401 | 0.05166 | 0.12148 | 0.10742 | 0.73195 | - | - | - |
| 81 to 85 | 0.34714 | 0.08824 | **0.00033** | **0.00043** | **0.00035** | **0.04139** | **0.03764** | - | - |
| 86 to 90 | 0.38511 | 0.18326 | **0.03311** | **0.06155** | 0.05903 | 0.23637 | 0.20154 | 0.82836 | - |
| 91 to 95 | 0.23803 | 0.12986 | **0.04213** | **0.06627** | 0.06458 | 0.16657 | 0.14705 | 0.46487 | 0.61286 |

**Interpretation :**

There is significant difference in FRT for people in 71 to 75, 81 to 85, 86 to 90 and 91 to 95 Age groups.

**9. <u>Comparison of TUG for different Age Group</u>**

Response Variable: TUG

Treatments: Different Age Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average TUG between different Age groups.

H1 : There is a significant difference in the average TUG between different Age groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 9 | 1888 | 209.75 | 2.27 | 0.0164 * |
| Residuals | 763 | 70510 | 92.41 | | |

**Decision & Conclusion**

As p - value < 0.05, H0 is Rejected.

The average TUG between people of different Age groups differ Significantly.

**Hypothesis to Test :**

H0 : Average TUG between two different Age Groups is same.

H1 : Average TUG between two different Age Groups is not same.

**<u>Post hoc Table</u>**

| | 40 to 50 | 51 to 55 | 56 to 60 | 61 to 65 | 66 to 70 | 71 to 75 | 76 to 80 | 81 to 85 | 86 to 90 |
|---|---|---|---|---|---|---|---|---|---|
| 51 to 55 | 0.77513 | - | - | - | - | - | - | - | - |
| 56 to 60 | 0.8478 | 0.84827 | - | - | - | - | - | - | - |
| 61 to 65 | 0.65016 | 0.82854 | 0.49465 | - | - | - | - | - | - |
| 66 to 70 | 0.46691 | 0.49772 | 0.15273 | 0.26242 | - | - | - | - | - |
| 71 to 75 | 0.40707 | 0.39706 | 0.09268 | 0.13685 | 0.67571 | - | - | - | - |
| 76 to 80 | 0.12756 | 0.05064 | **0.00148** | **0.00068** | **0.00941** | **0.02608** | - | - | - |
| 81 to 85 | 0.22316 | 0.15946 | **0.03003** | **0.04597** | 0.17634 | 0.277 | 0.557 | - | - |
| 86 to 90 | 0.11645 | 0.11775 | 0.08328 | 0.11309 | 0.16413 | 0.18812 | 0.42912 | 0.33379 | - |
| 91 to 95 | 0.28363 | 0.32024 | 0.27087 | 0.33352 | 0.41894 | 0.45484 | 0.74805 | 0.63571 | 0.79669 |

**Interpretation :**

There is significant difference in TUG for people in 76 to 80 and 81 to 85 Age groups.

**10. <u>Comparison of PEFR for different Age Group</u>**

Response Variable : PEFR

Treatments : Different Age Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average PEFR between different Age groups.

H1 : There is a significant difference in the average PEFR between different Age groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 9 | 305146 | 33905 | 3.529 | 0.000299 *** |
| Residuals | 478 | 4592210 | 9607 | | |

**Decision & Conclusion**

As p - value < 0.01, H0 is Rejected.

The average PEFR between people of different Age groups differ highly Significantly.

**Hypothesis to Test :**

H0: Average PEFR between two different Age Groups is same.

H1: Average PEFR between two different Age Groups is not same.

**The data is insufficient to perform Post Hoc Analysis.**

**1. <u>Comparison of Geriatric Depression Score (GDS) for different Fitness Group</u>**

Response Variable : GDS

Treatments : Different Fitness Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average GDS between different Fitness groups.

H1 : There is a significant difference in the average GDS between different Fitness groups.

**ANOVA Table**

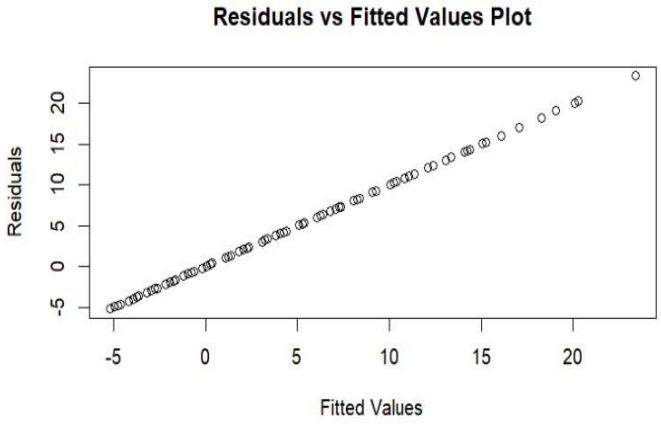
| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 3 | 15 | 5.008 | 0.206 | 0.893 |
| Residuals | 775 | 18877 | 24.358 | | |

**Decision & Conclusion**

As, p-value > 0.05, H0 is Accepted.

There is no significant difference in the average GDS between people of different Fitness groups.

**<u>Residual Plot</u>**




**Interpretation :**

The straight line indicates the residuals are normally distributed i.e. Assumption is satisfied.

**Constant Variance**

H0 : All population variances are equal.

H1 : At least two population variances are different.

**R Code :**

```
bartlett.test(gds ~Treatment, data = data1)
```

Bartlett test of homogeneity of variances

data: gds by Treatment

Bartlett's K-squared = 1.7185, df = 3, p-value = 0.6328

**Decision & Conclusion**

As p-value > 0.05, H0 is Accepted.

All population variances are equal.

**Hypothesis to Test :**

H0: Average GDS between two different Fitness Groups is same.

H1: Average GDS between two different Fitness Groups is not same.

**Post hoc Table**

| | Normal | Obese | Overweight |
|---|---|---|---|
| Obese | 0.49 | - | - |
| Overweight | 0.82 | 0.69 | - |
| Underweight | 0.66 | 0.84 | 0.73 |

**Interpretation :**

There is no significant difference in GDS for people in different Fitness group.

**2. <u>Comparison of MOCA for different Fitness Group</u>**

Response Variable: MOCA

Treatments: Different Fitness Group

**Hypothesis to Test :**

H0 : There is no significant difference in average MOCA between different Fitness groups.

H1 : There is a significant difference in the average MOCA between different Fitness groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 3 | 13 | 4.373 | 0.165 | 0.92 |
| Residuals | 777 | 20630 | 26.55 | | |

**Decision & Conclusion**

As p - value > 0.05, H0 is Accepted.

i.e. There is no significant difference in the average MOCA between people of different Fitness groups.

**Hypothesis to Test :**

H0 : Average MOCA between two different Fitness Groups is same.

H1 : Average MOCA between two different Fitness Groups is not same.

**<u>Post hoc Table</u>**

| | Normal | Obese | Overweight |
|---|---|---|---|
| Obese | 0.71 | - | - |
| Overweight | 0.88 | 0.59 | - |
| Underweight | 0.75 | 0.65 | 0.8 |

**Interpretation :**

There is no significant difference in MOCA for people in different Fitness group.

**3. <u>Comparison of QPAR for different Fitness Group</u>**

Response Variable : QPAR

Treatments : Different Fitness Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average QPAR between different Fitness groups.

H1 : There is a significant difference in the average QPAR between different Fitness groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 3 | 688 | 229.3 | 1.019 | 0.388 |
| Residuals | 89 | 20026 | 225 | | |

**Decision & Conclusion**

As p - value > 0.05, H0 is Accepted.

There is no significant difference in the average QPAR between people of different Fitness groups.

**The data is insufficient to perform Post Hoc Analysis.**

**4. Comparison of OPQOL for different Fitness Group**

Response Variable : OPQOL

Treatments : Different Fitness Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average OPQOL between different Fitness groups.

H1: There is a significant difference in the average OPQOL between different Fitness groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 3 | 526 | 175.5 | 0.383 | 0.765 |
| Residuals | 88 | 40307 | 458 | | |

**Decision & Conclusion**

As p - value > 0.05, H0 is Accepted.

There is no significant difference in the average OPQOL between people of different Fitness groups.

**The data is insufficient to perform Post Hoc Analysis.**

**5. <u>Comparison of TMT A for different Fitness Group</u>**

Response Variable : TMT A

Treatments : Different Fitness Group

**Hypothesis to Test:**

H0: There is no significant difference in the average TMT A between different Fitness groups.

H1: There is a significant difference in the average TMT A between different Fitness groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 3 | 1452 | 484.1 | 0.424 | 0.736 |
| Residuals | 528 | 602842 | 1141.7 | | |

**Decision & Conclusion**

As p - value > 0.05, H0 is Accepted.

There is no significant difference in the average TMT A between people of different Fitness groups.

**Hypothesis to Test :**

H0 : Average TMT A between two different Fitness Groups is same.

H1 : Average TMT A between two different Fitness Groups is not same.

**<u>Post hoc Table</u>**

| | Normal | Obese | Overweight |
|---|---|---|---|
| Obese | 0.58 | - | - |
| Overweight | 0.53 | 0.84 | - |
| Underweight | 0.44 | 0.35 | 0.33 |

**Interpretation :** There is no significant difference in TMT A for people in different Fitness group.

**6. <u>Comparison of TMT B of different Fitness Group</u>**

Response Variable: TMT B

Treatments: Different Fitness Group

**Hypothesis to Test :**

H0: There is no significant difference in the average TMT B between different Fitness groups.

H1: There is a significant difference in the average TMT B between different Fitness groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 3 | 43484 | 14495 | 0.333 | 0.802 |
| Residuals | 450 | 19605598 | 43568 | | |

**Decision & Conclusion**

As p - value > 0.05, H0 is Accepted.

There is no significant difference in the average TMT B between people of different Fitness groups.

**Hypothesis to Test :**

H0 : Average TMT B between two different Fitness Groups is same.

H1 : Average TMT B between two different Fitness Groups is not same.

| | Normal | Obese | Overweight |
|---|---|---|---|
| Obese | 0.49 | - | - |
| Overweight | 0.83 | 0.38 | - |
| Underweight | 0.97 | 0.83 | 0.98 |

**Interpretation :**

There is no significant difference in TMT B for people in different Fitness group.

**7. <u>Comparison of MWT of different Fitness Group</u>**

Response Variable: MWT

Treatments: Different Fitness Group

**Hypothesis to Test :**

H0: There is no significant difference in the average MWT between different Fitness groups.

H1: There is a significant difference in the average MWT between different Fitness groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 3 | 3424 | 1141 | 0.439 | 0.725 |
| Residuals | 602 | 1566405 | 2602 | | |

**Decision & Conclusion**

As p - value > 0.05, H0 is Accepted.

There is no significant difference in the average MWT between people of different Fitness groups.

**Hypothesis to Test :**

H0 : Average MWT between two different Fitness Groups is same.

H1 : Average MWT between two different Fitness Groups is not same.

| | Normal | Obese | Overweight |
|---|---|---|---|
| Obese | 0.65 | - | - |
| Overweight | 0.65 | 0.92 | - |
| Underweight | 0.4 | 0.29 | 0.29 |

**Interpretation :**

There is no significant difference in MWT for people in different Fitness group.

**8. <u>Comparison of FRT of different Fitness Group</u>**

Response Variable: FRT

Treatments: Different Fitness Group

**Hypothesis to Test :**

H0: There is no significant difference in the average FRT between different Fitness groups.

H1: There is a significant difference in the average FRT between different Fitness groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 3 | 1058 | 352.7 | 2.574 | 0.0529 |
| Residuals | 721 | 98765 | 137 | | |

**Decision & Conclusion**

As p - value > 0.05, H0 is Accepted.

There is no significant difference in the average FRT between people of different Fitness groups.

**Hypothesis to Test :**

H0 : Average FRT between two different Fitness Groups is same.

H1 : Average FRT between two different Fitness Groups is not same.

| | Normal | Obese | Overweight |
|---|---|---|---|
| Obese | **0.0078** | - | - |
| Overweight | 0.0605 | 0.7111 | - |
| Underweight | 0.19 | 0.6489 | 0.5712 |

**Interpretation :**

There is significant difference in FRT for people belonging to Obese and Normal Fitness groups.

**9. <u>Comparison of TUG of different Fitness Group</u>**

Response Variable: TUG

Treatments: Different Fitness Group

**Hypothesis to Test :**

H0: There is no significant difference in the average TUG between different Fitness groups.

H1: There is a significant difference in the average TUG between different Fitness groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 3 | 1373 | 457.7 | 4.956 | 0.00206 ** |
| Residuals | 769 | 71025 | 92.4 | | |

**Decision & Conclusion**

As p - value < 0.01, H0 is Rejected.

There is significant difference in the average TUG between people of different Fitness groups.

**Hypothesis to Test :**

H0 : Average TUG between two different Fitness Groups is same.

H1 : Average TUG between two different Fitness Groups is not same

| | Normal | Obese | Overweight |
|---|---|---|---|
| Obese | 0.89347 | - | - |
| Overweight | 0.48439 | 0.48509 | - |
| Underweight | **0.00019** | **0.00016** | **0.00057** |

**Interpretation :**

There is significant difference in TUG for people belonging to Underweight Fitness groups.

**10. <u>Comparison of PEFR for different Fitness Group</u>**

Response Variable : PEFR

Treatments : Different Fitness Group

**Hypothesis to Test :**

H0 : There is no significant difference in the average PEFR between different Fitness groups.

H1 : There is a significant difference in the average PEFR between different Fitness groups.

**ANOVA Table**

| | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Treatment | 3 | 39755 | 13252 | 1.32 | 0.267 |
| Residuals | 484 | 4857601 | 10036 | | |

**Decision & Conclusion**

As p - value > 0.05, H0 is Accepted.

There is no significant difference in the average PEFR between people of different Fitness groups.

**Hypothesis to Test :**

H0 : Average PEFR between two different Fitness Groups is same.

H1 : Average PEFR between two different Fitness Groups is not same.

| | Normal | Obese | Overweight |
|---|---|---|---|
| Obese | 0.17 | - | - |
| Overweight | 0.518 | 0.545 | - |
| Underweight | 0.088 | 0.209 | 0.152 |

**Interpretation :**

There is no significant difference in PEFR for people in different Fitness group.

# ODD'S RATIO

Odds provides measure of likelihood of a particular outcome. Odds are calculated as number of events that produce outcomes to the number of events that do not produce outcome.

In statistics odds are an expression of Relative Probabilities. The odds in the favour of an event is probability that an event will happen to the probability that an event will not happen.

Odd's Ratio is statistics that quantifies the strength of association between two events. Odds ratio is used to find probability of an event when there are two possible outcomes and there is one casual effect.

**Formula :**

$$\text{Odd's Ratio} = \frac{\text{Odds of the Event in the Primary Group}}{\text{Odds of the Event in the Comparison Group}}$$

**Interpretation :**

- Odd's Ratio (OR) = 1
  The event is Equally likely in both the groups.
- Odd's Ratio (OR) > 1
  The event is More likely in the group of interest.
- Odd's Ratio (OR) < 1
  The event is Less likely in the group of interest.

**R Code :**

```
> oddsratio(HTN)
$data
```

| | HTN_YES | HTN_NO | Total |
|---|---|---|---|
| Male | 159 | 127 | 286 |
| Female | 185 | 112 | 297 |
| Total | 344 | 239 | 583 |

```
$measure
                    NA
odds ratio with 95% C.I.    estimate      lower          upper
                Male        1.0000000     NA             NA
                Female      0.7584635     0.5440579      1.055875

$p.value
        NA
two-sided     midp.exact    fisher.exact    chi.square
  Male          NA            NA              NA
  Female      0.1014975     0.1097569       0.1003512
```

**R Code :**

```
> oddsratio(DM)
  $data
```

| | DM_YES | DM_NO | Total |
|---|---|---|---|
| Male | 122 | 156 | 278 |
| Female | 114 | 175 | 289 |
| Total | 236 | 331 | 567 |

```
$measure
                    NA
odds ratio with 95% C.I.    estimate     lower        upper
              Male          1.000000     NA           NA
              Female        1.200014     0.8587796    1.678169

$p.value
        NA
two-sided    midp.exact    fisher.exact    chi.square
  Male          NA            NA              NA
  Female      0.2855309       0.3068268       0.2837901
```

**Interpretation :**

Females have approximately 20.00% higher odds of having Diabetes Mellitus as compared to Males.

As p – value > 0.05

The odds ratio is not statistically significant.

**R Code :**

```
> oddsratio(med)
$data
```

| | Med History_YES | Med History_NO | Total |
|---|---|---|---|
| Male | 103 | 54 | 157 |
| Female | 117 | 78 | 195 |
| Total | 220 | 132 | 352 |

```
$measure
                    NA
odds ratio with 95% C.I.     estimate       lower          upper
                Male         1.000000       NA             NA
                Female       1.270075       0.8212586      1.972364

$p.value
        NA
two-sided    midp.exact    fisher.exact    chi.square
  Male            NA            NA             NA
  Female      0.2831087     0.3191297      0.2802536
```

**Interpretation :**

Females have approximately 27.00 % higher odds of having medical history as compared to Males.

As p – value > 0.05

The odds ratio is not statistically significant.

> oddsratio(Sx)

$data

| | Sx History_YES | Sx History_NO | Total |
|---|---|---|---|
| Male | 166 | 30 | 196 |
| Female | 219 | 35 | 254 |
| Total | 385 | 65 | 450 |

$measure

NA

| odds ratio with 95% C.I. | estimate | lower | upper |
|---|---|---|---|
| Male | 1.0000000 | NA | NA |
| Female | 0.8840065 | 0.520752 | 1.508396 |

$p.value

NA

| two-sided | midp.exact | fisher.exact | chi.square |
|---|---|---|---|
| Male | NA | NA | NA |
| Female | 0.6487459 | 0.6859854 | 0.6478437 |

**Interpretation :**

Females have approximately 11.6% lower odds of having surgical history as compared to males.

The odds of having surgical history for females are 0.884 times the odds for males.

As p – value > 0.05

The odds ratio is not statistically significant.

> oddsratio(x1)

$data

| | Medication_YES | Medication_NO | Total |
|---|---|---|---|
| Male | 123 | 35 | 158 |
| Female | 135 | 49 | 184 |
| Total | 258 | 84 | 342 |

$measure

NA

odds ratio with 95% C.I. estimate lower upper

Male 1.000000 NA NA

Female 1.273392 0.7749071 2.10923

$p.value

NA

two-sided midp.exact fisher.exact chi.square

Male NA NA NA

Female 0.3413536 0.3785452 0.3374269

**Interpretation :**

Females have approximately 27.34% higher odds of having Medication as compared to Males.

As p – value > 0.05

The odds ratio is not statistically significant.