IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 13, 2022

ASSESSING HEALTH INEQUITIES: A COMPARATIVE ANALYSIS OF MALE AND FEMALE HEALTH OUTCOMES ACROSS INDIAN STATES

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Abstract:

Health remains the most important aspects of human well-being. Gender differences are not only related to biological factors but also to socio-economic and cultural factors. The objective of the study is to compare health status of men and women using selected health indicators and to analyse the relation between Work Force Participation Rate (WFPR) and lower BMI, Overweight/obese. Results pointed out that percentage of women whose body mass index is below normal are found higher than men whose body mass index is below normal. In terms of overweight / obesity percentage of women are more than men. While, the regression analysis for NFHS-5 data provides mixed results, lower BMI for women is negatively associated with Work Force Participation rate of female (WFPRF) and overweight or obese is positively associated for women. For male, relation between lower BMI and WFPR found positive, while the relation between Work Force Participation Rate and Overweight/ Obese is found negative in regression analysis using NFHS-5 data.

Key words: Gender differences, BMI, Overweight / Obese, Health indicators

JEL code: I10, I12, I14

Introduction:

One of the most important aspects of human well-being is nutrition. It plays a crucial role in other areas of well-being. Both men and women need to consume enough food to stay healthy. Men and Women should have the same opportunities and free environments to achieve their full rights and ability to be healthy, contribute to healthy growth. This is what is meant by gender equality in health. However, because of the crucial but complex relationship between women's nutrition and their well-being and for the advancement of humanity, women's nutrition acquires additional significance (Jose & Navaneetham, 2008). Women's health encompasses not only biological problems but also psychological and sociocultural elements that eventually have an impact on women's state of health. The study of women's health aims to advance knowledge of the psychological and biological variables that affect women's health and to incorporate this knowledge into public health programmes (Purnima, 2008). Women are less likely to have access to everything, including food, resources, health care, community support, and information due to social and cultural inequality. Cultural,

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political, and economic realities are the root causes of these issues (Dewan, 2008) (Purnima, 2008). A significant rise in the risk of mortality and morbidity has been related to malnutrition, which is a critical public health issue, particularly in developing nations. There are about 189.2 million undernourished people in India; a majority of whom are women and children (Gupta, 2022). In this exercise, we consider the health status of both men and women. Men live shorter but healthier lives, whereas women live longer but inferior health generally we found. (Austad, 2006). Women have lived longer than men globally since 2006, yet curiously, they also report greater disease than men (Barford et al., 2006). In several nutrition-related aspects, there are considerable gender-specific variances.

Keeping in mind this background, the goal of this research has been set from the beginning. Rather than addressing questions of causality or offering an explanation, it focuses on providing a preliminary factsheet on the health status of men and women throughout selected Indian states. The study is intended to compare health status of men and women using some specific variables like lower BMI and overweight /obese. Broad objectives are as follows.

Objective of the research:

- To know the status of men and women health across the states of India with some selected health indicators using NFHS-4 and 5 data
- To analyse the relation between work force participation rate with lower BMI, overweight/ obese

According to the above-mentioned objectives, the following literature reviews have been considered for this research exercise.

Literature Reviews:

(Barker et al., 2006) identify social and economic factors associated with thinness and to explore the behaviour in men and women. Study has been carried out in 6 villages in of the Pune district of Maharashtra. Result shows that women were thinners in joint land-owning families because of women in developing countries bearing the burden of a ‘double day’ to fulfil both their working and domestic roles. Households with more cash wealth women had lower BMIs than men – this indicates that household resources are not allocated equally to men and women. One more variable – strict fasting practises of women reduces women’s nutritional status.

Sengupta and Syamala analyze the NFHS-2 & 3 data to access malnutrition levels and trends (Sengupta & Syamala, 2012). The result shows that states like Delhi, Punjab, and Kerala should pay greater attention to the overweight problem.

(Saikia et al., 2016) examine the gender differences in health care expenditure in short-term using two rounds of India’s human development survey 2004 – 05 and 2011-12. They found that health care expenditure on females was systematically lower than on males across all demographic and socio–economic groups.

(Dutta et al., 2019) assessed the determinants of underweight and overweight/obese in India among adult men and women aged 15-49. Data were taken from NFHS-4. Results show that the prevalence of both underweight and overweight / obesity were higher among women than men. The result shows a high underweight prevalence found in Uttar Pradesh, Bihar, and Madhya Pradesh. While a high prevalence of overweight /obesity was found in Goa. Among

women Bihar and Jharkhand displayed a higher prevalence of underweight than the other States. Punjab, Goa and Delhi displayed a high prevalence of overweight / obesity.

After having analysed the reviews, this study proposes to find the prevalence of disparities with respect to BMI, and overweight/obese for men and women using NFHS-4 and 5 data. Using work force participation rate for male and female, regression equation is also experimented to estimate the relationship between WFPR and health indicators.

Research Methodology:

The data for the present study are taken from the 4th and 5th rounds of the National Family Health Survey (NFHS-4 and NFHS-5) conducted during 2015-16 and 2019-21, respectively. NFHS-4 provides data on 29 states, 6 union territories (UTs) and NCT Delhi (Ministry of Health and Family Welfare). NFHS-5 provides data on 28 states and 7 UTs. NFHS-4 corporates 29 states but NFHS-5 corporates 28 states because in NFHS-4 Jammu – Kashmir consider as a state while in NFHS-5 it is considered as a UT (Ministry of Health and Family Welfare, 2021). So, we exempt Jammu – Kashmir and finally we analysed 28 states data. NFHS-4 and NFHS-5 are comparable over a time. The major objective of this attempt is to provide state-level estimates on men's and women's health related indicators such as lower Body Mass Index (BMI) and overweight or obese (OW). Anaemia is also an indicator of health and nutrition. But the data on anaemia are not comparable so it is not considered in this study.

Person's nutritional status is expressed in terms of their BMI. Anthropometric measurements such as BMI are computed based on a person's height and weight. A person is considered thin or underweight if his BMI is less than 18.5 kg/m^2, whereas those with BMIs between 25 - 29.9 kg/m^2 and greater than 30 kg/m^2 are categorised as overweight and obese respectively (Jose & Navaneetham, 2008). This exercise considers both men and women whose body mass index is below normal and who are overweight or obese

All the variables included in this research exercise are basic indicators of health. For comparison, the normalized value of each indicator is counted. Therefore, standard process is adopted according to the following formula.

- For negative indicator = $(Max_i - X_i) / (Max_i - Min_i)$

Max_i = Maximum value of each indicator

$Mini_i$ = Minimum value of each indicator

X_i = Actual value of each indicator

We used this formula because variables included in this study are negative indicators of human health. Table 1 and Table 2 provides the actual value of each indicator across the states in NFHS-5 and NFHS-4. Table 3 and Table 4 provides normalized value using above formula for NFHS-5 and NFHS-4. After having the normalized value, ranking of states according to their outcome are given and comparison is made across the states of India. The normalized value lies between 0 to 1. The value which is closer to 1 or equal to 1 indicates better conditions while the value closer to 0 or equal to 0 indicates worst condition. Table 5 and Table 6 provide the actual position of States among 28 states. Table 7 compares the state's health status between NFHS – 4 and NFHS-5. Table 7 pointed out of overall (Urban and Rural) health status of men and women and compare among 28 states from NFHS - 4 to NFHS - 5.

Apart from this, an attempt has been made to analyse the relation between work force participation rate with lower BMI and OW data of men and women using regression equation. Data for work force participation rate has been taken from Ministries of Statistics and Programme Implementation (MoSPI). For comparison between BMI and overweight or obese (OW) with work force participation, respective data for various states have been considered. For, BMI and OW, NFHS-4 and 5 data are used. While, to make comparison appropriate with respective years of both of these surveys, data on WFPR are considered for 2017-18 and 2019-20 from various sources like, MoSPI, website of Reserve Bank of India (RBI) and other relevant sources. The following regression equation is prepared for estimation. Here, the rationale for using regression is to justify the association between health indicators and work force participation. As, workforce participation increases, impact has been observed in BMI and OW of both men and women.

$Y = \beta_0 + \beta_1 X + \varepsilon$ ..... (1)

Equation-1 is a generalised form of linear regression where Y stands for the dependent variable while X stands for independent variable. ε is the estimation error. With respect to this exercise, BMI and OW of men and women for NFHS-5 data across the states of India are considered as dependent variables and WFPR for men and women are taken as independent variables.

Results of the study:

The following observations have been obtained for NFHS-5 data. In terms of lower BMI for women in NFHS- 5 (2019-21), Mizoram secured first rank in urban area, while Sikkim obtained the first rank in the rural area. Bihar comes last in urban and Gujarat comes last in rural areas with 24th rank. In case of BMI for men, Mizoram and Sikkim secured first rank in urban and rural areas respectively. The highest percent of men whose BMI is below normal is found in Uttarakhand and Gujarat for urban and rural areas with 23rd and 24th rank respectively. If we consider women who are overweight or obese (OW), Nagaland and Jharkhand have achieved 1st rank in urban and rural areas respectively. The highest percentage of women who are overweight or obese (OW) are found in Tamil Nadu and Punjab for urban and rural areas respectively. While considering women who are overweight or obese (OW), Gujarat ranks 14th in urban and 8th in rural areas. In case of men who are overweight or obese, Bihar and Meghalaya secured 1st rank in urban and rural areas respectively. While, the highest percentage of men who are overweight or obese are found in Tamil Nadu both in urban and rural areas. Gujarat ranks 7th in both urban and rural areas in terms of men who are overweight or obese.

Table 7 pointed overall (Urban & Rural) picture of health status across the states of India for NFSH-4 and 5. In case of women whose BMI is below normal – Sikkim secured the first rank in NFHS-4 and Mizoram is at first rank in NFHS-5, while the last rank secured by Jharkhand in both NFHS-4 and NFHS-5. – Out of 28 states, 19 states have improved their women BMI below normal from NFHS-4 to NFHS-5. Women BMI status has been deteriorated in Goa, Haryana, Maharashtra, Meghalaya, Punjab, Sikkim, and Uttar Pradesh from NFHS-4 to NFHS-5, while Arunachal Pradesh and Kerala are the two States have remained stable from NFHS-4 to NFHS-5. Sikkim has secured first rank in men whose BMI is below normal in NFHS-4 while, Andhra Pradesh and Sikkim secured first rank in NFHS-5. There are 17 states

out of 28 states which have improved BMI for men below normal. BMI for men has been deteriorated in Andhra Pradesh, Goa, Haryana, Karnataka, Kerala, Maharashtra, Punjab, and Uttar Pradesh from NFHS-4 to NFHS-5. While, Mizoram, Tamil Nadu and West Bengal are these three states remained stable from NFHS-4 to NFHS-5.

For women who are overweight or obese, Jharkhand and Meghalaya have obtained first rank in NFHS-4 & NFHS-5 respectively, while the last rank observed in Goa and Punjab for NFHS-4 and NFHS-5 respectively. Out of 28 states 11 states have improved their rank, while 16 states have deteriorated their rank from NFHS-4 to NFHS-5 in women who are overweight or obese. While Mizoram has remained stable on its rank for this period. With respect to the men who are overweight or obese Meghalaya have secured first rank in both NFHS - 4 and NFHS - 5 respectively, while the last rank obtained by Sikkim and Tamil Nadu in NFHS - 4 and NFHS - 5 respectively. 14 states out of 28 states have improved their rank while Haryana, Kerala, Madhya Pradesh, Manipur, Mizoram, Nagaland, Tamil Nadu, Telangana and Uttarakhand have worsened their rank from NFHS-4 to NFHS-5. The states whose rank remained stable from NFHS-4 to NFHS-5 are consists of Chhattisgarh, Himachal Pradesh, Karnataka, Punjab, and Tripura.

With respect to the findings of association between BMI and WFPR for both male and female for NFHS-5 data, significant and negative association has been found between lower BMI of female and WFPR for female across the states of India. The coefficient of association has been found to be -0.461 which is significant at 1 % significant level indicating 1 % change WFPR for female significantly and negatively effecting to the lower BMI of women for all the states. The results are given in **table 9**. There is rationale for this result as the WFPR increases for the female, they become economically independent therefore they take their own decisions may result in improvement in lower BMI. For male, the result is opposite indicating there is a positive association between BMI of men and WFPR of male. The coefficient of association has been found to be 0.230 which is significant at 1 % significant level indicating 1 % change in WPFR for male significantly and positively increasing lower BMI for male can be seen in **table 10**. The rationale may be for such association lies in the lack of opportunities. As, the WFPR for male improves, their lower BMI is also increase indicating a deterioration in the health status for men. The rationale for the same would be job related stress.

The second linear association is experimented with OW and WFPR for both male and female for NFHS-5 data across the states of India. Accordingly, there has been positive association found between WFPR for female and OW of women. The coefficient of association has been found to be 0.605 which is significant at 1 % significant level suggesting if there is 1 % change in WFPR for female positively and significantly increasing OW for women across the states of India and are given in **table 11**. The possible reason would be as the income sources have been increasing, the OW indicator changes positively. With respect to the OW for men, the coefficient of association has been found to be negative which is -0.269 and it is significant at 1% significant level. The interpretation of which would be 1 % change in WFPR for male reduces the OW for men by 0.269 % significantly which can be found in **table-12**. As, the work force participation has improved for male, the OW indicator shows reduction. The rationale would be as work force participation increases for men, their

physical activities are also increasing, therefore there is reduction in this indicator. All the coefficients are robust as their respective diagnostic tests such as collinearity, autocorrelation and normality are satisfied for each of the regression coefficient calculated. The respective tests and results can be found in **table-12,** while the confirmatory figures are **figure 1, 2, 3 and 4**.

Absolute comparison of the first and last ranked states in health indicators with WFPR the following results have been obtained. An inverse relationship exists between women whose BMI is below normal and WFPR for female. In this study, we found that Mizoram secured first rank and Jharkhand secured last rank in women body mass index is below normal in NFHS-5(2019-21). Which means Mizoram is having lower percentage of women whose BMI is below normal. Female work force participation rate was higher in Mizoram (33.3 %) while lower in Jharkhand (13.3 %) in 2019-20(MoSPI 2017-18 & 2019-20). Which implies negative relation between women whose BMI is below normal and work force participation rate.

Relation between men whose BMI is below normal and workforce participation rate is not conclusive. In men whose body mass index is below normal, Sikkim and Arunachal Pradesh obtained First rank in NFHS-5. Bihar obtained last rank in NFHS-5. While considering the work force participation rate in Sikkim and Arunachal Pradesh we can see 35.3 % & 24.4 % in 2019-21. Bihar's WFPR data were not available. So we can't take any decision.

There is no such relation exists between overweight/obesity and female workforce participation rate. As we found that Meghalaya secured first rank in women who are overweight or obese in NFHS-5. Which means in Meghalaya we find lower percentage of overweight/obese women. Female work force participation rate in Meghalaya, is 34.1%, while in Punjab it is found 32.1% which is quite similar. (Ministry of Labour and Employment, 2022).

In the case of men who are overweight or obese, there is a positive relation exists between work force participation rate and overweight/obesity. In this study, Meghalaya secured first rank, while Tamil Nadu secured lowest rank in men who are overweight or obese in NFHS-5. Consideration of the male workforce participation rate, Meghalaya is having 24.5 % in 2019-20, while Tamil Nadu is having 32.8% in 2019-20 (MoSPI 2017-18 & 2019-20). This means higher the men work force participation rate higher will be the overweight/ obese among men.

Conclusion:

BMI is below normal is found higher in women as compared to men in NFHS-4 and NFHS-5. Percentage of rural women whose BMI is below normal are higher than urban women. Barker and Chorghade et. al., study might explain our findings, they claimed that double burden of workload (Household chores and farming), strict fasting practises, women are more likely to eat last at meal times are responsible for lower BMI (Barker et al., 2006). Female labour force participation rate has gone up from 18.6 % in 2018-19 to 25.1% in 2020-21. Apart from this, notable rise in rural female labour force participation rate from 19.7% in 2018-19 to 27.7 % in 2020-21(Ministry of Finance, 2023). In terms of overweight or obese percentage of women who are found higher than men across the states of India in both NFHS-4 and NFHS-5. One of the reasons for higher overweight among women as per Kanter

and Caballero et, al., is the fat distribution is affected by biological menopausal factors, which may increase the risk. (Kanter & Caballero, 2012). Percentage of overweight or obese in men and women are higher in urban areas. Similar result found in Gouda and Prusty's study shows that the prevalence of overweight and obesity is very high in urban areas (Gouda & Prusty, 2014). Apart from this, higher percentage of overweight people found in urban areas because of switch to western meals and lifestyles, decreased physical exercise, and increased the level of transportation facilities (Gouda & Prusty, 2014). In the consideration of high-risk waist to hip ratio was also found higher in women than men in NFHS-5. Study pointed out that percentage of overweight or obese women are higher in urban area than rural area. Similar result found that - compared to men, older women were more likely to have a high-risk waist to hip ratio. (Muhammad et al., 2022).

Moreover, the results of coefficients of association are slightly different than the results obtained by the absolute comparison of various health indicators. The study is limited to the data used and for the Indian context only. There may be many other statistical methods which can also be applied for such sort of study but this study is limited to the statistical techniques and tools used for it.

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ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 13, 2022

Table -1 Actual value of each indicator across the States of India (NFHS-5)

States	Women whose body mass index is below normal			Men whose body mass index is below normal			Women who are overweight or obese			Men who are overweight or obese		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Andhra Pradesh	11.9	16.2	14.8	15	17.2	16.5	44.4	32.6	36.3	37.7	28	31.1
Arunachal Pradesh	5.6	5.7	5.7	6.4	4.6	4.9	28.9	22.9	23.9	32.4	26.6	27.6
Assam	13.9	18.3	17.6	11.3	13.8	13.4	23.8	13.6	15.2	25.4	14.5	16.2
Bihar	18.7	26.9	25.6	12.9	23.8	21.5	25.2	14.2	15.9	18.7	13.6	14.7
Chhattisgarh	16	25.3	23.1	11.1	19.4	17.4	23.1	11.3	14.1	22.4	12.7	14.9
Goa	13.1	15	13.8	9.3	18.4	12.5	38.1	33.1	36.1	32.5	32.8	32.6
Gujarat	17.2	30.9	25.2	16	24.7	20.9	30.4	17	22.6	25.6	15.6	19.9
Haryana	11.4	16.9	15.1	15	14.3	14.5	37.5	30.9	33.1	30.2	27.4	28.3
Himachal Pradesh	9.8	14.5	13.9	6.6	12.7	11.8	38.3	29.2	30.4	35.7	29.8	30.6
Jharkhand	17.3	29.2	26.2	12.1	18.9	17.1	21.6	8.6	11.9	21.7	12.8	15.1
Karnataka	12.9	19.9	17.2	11.5	16.2	14.3	37.1	25.6	30.1	39.4	25	30.9
Kerala	9.7	10.4	10.1	6.9	12.7	10	40.4	36	38.1	40.1	33.2	36.4
Madhya Pradesh	17.1	25.2	23	17.7	21.8	20.8	26	13	16.6	25.7	12.1	15.6
Maharashtra	15.8	25	20.8	15.3	16.9	16.2	29.6	18.3	23.4	28.9	21.3	24.7
Meghalaya	10.2	11	10.8	8.6	9.1	9	17.9	9.7	11.5	30.2	10.6	13.9
Manipur	6.1	7.9	7.2	7.6	8.3	8	39	31	34.	33.4	27.9	30.

									1			3
Mizoram	4.2	6.8	5.3	2.6	8	5.1	29.7	16.9	24.2	38.3	24.2	31.9
Nagaland	11.6	10.8	11.1	7.4	7.5	7.5	17.1	13	14.4	31	19.8	23.9
Odisha	12.6	22.6	20.8	10.9	16.5	15.3	40.1	19.2	23	32.2	19.7	22.2
Punjab	11.9	13.1	12.7	11.2	13.5	12.5	44.3	38.8	40.8	35.2	30.2	32.2
Rajasthan	14	21.3	19.6	11	15	14	20.6	10.5	12.9	19.1	13.6	15
Sikkim	6.1	5.6	5.8	5.8	4.4	4.9	41	30.8	34.7	40.1	33.9	36.3
Tamil Nadu	9.7	15.2	12.6	11.3	12.8	12.1	46.1	35.4	40.4	43.1	31.6	37
Telangana	13.5	21.6	18.8	15.2	16.8	16.2	41.7	23.8	30.1	40.2	28.1	32.3
Tripura	14.6	16.9	16.2	13.2	12.1	12.4	29.2	18.4	21.5	28.3	21.4	23.4
Uttarakhand	11.6	14.9	13.9	20.7	14.1	16.2	39.1	25.4	29.7	31.4	25	27.1
Uttar Pradesh	13.6	20.8	19	13.4	19.5	17.9	30.6	18.3	21.3	24.9	16.2	18.5
West Bengal	9.5	17.4	14.8	11.5	16.8	15.1	27.9	20.3	22.7	20	14.5	16.2

Source - (Ministry of Health and Family Welfare, 2019-21)

Table -2 Actual value of each indicator across the States of India (NFHS-4)

States	Women whose body mass index is below normal			Men whose body mass index is below normal			Women who are overweight or obese			Men who are overweight or obese		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Andhra Pradesh	11.5	20.3	17.6	11.5	16.5	14.8	45.6	27.6	33.2	44.4	28	33.5
Arunachal Pradesh	8.7	8.5	8.5	8.8	8.1	8.3	25.8	16.3	18.8	26	18.4	20.6
Assam	17.9	27	25.7	15.4	21.7	20.7	26.1	10.9	13.2	24.8	10.5	12.9
Bihar	22.2	31.8	30.4	18.9	26.9	25.4	23.5	9.7	11.7	20.1	10.9	12.6
Chhattisgarh	17.6	29.6	26.7	21.1	25.2	24.1	24.4	7.8	11.9	20	6.8	10.2

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 13, 2022

States	Women whose body mass index is below normal			Men whose body mass index is below normal			Women who are overweight or obese			Men who are overweight or obese		
Goa	10.3	22.2	14.7	8.4	14.7	10.8	36.3	28.5	33.5	35.3	28.2	32.6
Gujarat	18.1	34.3	27.2	19	29.6	24.7	34.5	15.3	23.7	25.9	14.4	19.7
Haryana	12.2	18.2	15.8	9	12.9	11.3	24.3	18.8	21	21	19.3	20
Himachal Pradesh	11.7	16.7	16.2	18.5	17.9	18	38.4	27.6	28.6	26.9	21	22
Jharkhand	21.6	35.4	31.5	19.4	25.6	23.8	21.7	5.9	10.3	19.8	7.5	11.1
Karnataka	16.2	24.3	20.7	14.2	18.4	16.5	31.8	16.6	23.3	28.6	17.1	22.1
Kerala	9.1	10.2	9.7	8.4	8.6	8.5	33.5	31.5	32.9	31.1	26.3	28.5
Madhya Pradesh	20.6	31.8	28.4	22.5	31.1	28.4	23.8	9.1	13.6	17.6	7.8	10.9
Maharashtra	16.8	30	23.5	14.5	23.7	19.1	32.4	14.6	23.4	31.2	16.4	23.8
Manipur	8.5	9	8.8	11.5	10.9	11.1	31.2	22.4	26	21.8	18.5	19.8
Meghalaya	11.4	12.3	12.1	13.6	11.1	11.6	18.4	10.2	12.2	17.1	8.1	10.1
Mizoram	7.5	9.6	8.4	6	9.2	7.3	26.8	12.5	21	28.1	10	20.9
Nagaland	12.9	11.8	12.3	12.8	10.6	11.5	20.7	13.3	16.2	16.6	12.1	13.9
Odisha	15.8	28.7	26.5	12.6	21.4	19.5	32	13.2	16.5	32.4	13.3	17.2
Punjab	9	13.5	11.7	8.9	12.3	10.9	32.4	30.6	31.3	32.1	25	27.8
Rajasthan	18.6	29.9	27	16.7	25.1	22.7	23.7	10.7	14.1	19.7	10.6	13.2
Sikkim	7.5	5.8	6.4	1.2	3.3	2.4	34.1	23.1	26.7	41.5	29.7	34.8
Tamil Nadu	10.9	18.5	14.6	10.7	14.3	12.4	36.2	25.4	30.9	30.6	25.6	28.2
Telangana	15.9	29	22.9	17.8	24.6	21.5	40.2	18.5	28.6	31.7	17.9	24.2
Tripura	16.2	20.1	18.9	13	17	15.7	23.5	12.8	16	18.2	14.9	15.9
Uttarakhand	17.6	28.1	25.3	18.6	29.1	25.9	27.1	12.6	16.5	20.6	9	12.5
Uttar Pradesh	15.5	20	18.4	12.5	18.5	16.1	28.4	16	20.4	23	14.1	17.7
West Bengal	14.1	24.6	21.3	19	20.3	19.9	30.6	15	19.9	20.6	11.2	14.2

Source -(Ministry of Health and Family Welfare,2015-16)

Table -3 Normalized value of each indicator across the States of India (NFHS-5)

States	Women whose body mass index is below normal			Men whose body Mass index is below normal			Women who are overweight or obese			Men who are overweight or obese		
	Urba	Rur	Tot	Urba	Rur	Tota	Urba	Rur	Tot	Urba	Rur	Tota

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States	Women whose body mass index is below normal			Men whose body Mass index is below normal			Women who are overweight or obese			Men who are overweight or obese		
	n	al	al	n	al	l	n	al	al	n	al	l
Andhra Pradesh	0.47	0.58	0.54	0.31	0.37	0.30	0.06	0.205	0.15	0.22	0.25	0.25
Arunachal Pradesh	0.903	0.996	0.98	0.79	0.99	1	0.59	0.53	0.58	0.44	0.31	0.41
Assam	0.33	0.5	0.41	0.52	0.54	0.49	0.77	0.83	0.87	0.72	0.83	0.9
Bihar	0	0.16	0.03	0.43	0.04	0	0.72	0.81	0.85	1	0.87	0.96
Chhatisgarh	0.19	0.22	0.15	0.53	0.26	0.25	0.79	0.91	0.91	0.85	0.91	0.96
Goa	0.39	0.63	0.59	0.63	0.31	0.54	0.27	0.19	0.16	0.43	0.04	0.19
Gujarat	0.103	0	0.05	0.26	0	0.04	0.54	0.72	0.62	0.71	0.78	0.74
Haryana	0.503	0.55	0.53	0.31	0.51	0.42	0.29	0.26	0.26	0.53	0.28	0.38
Himachal Pradesh	0.61	0.65	0.59	0.78	0.59	0.58	0.27	0.32	0.35	0.3	0.17	0.28
Jharkhand	0.09	0.06	0	0.47	0.28	0.26	0.84	1	0.98	0.88	0.905	0.95
Karnataka	0.4	0.43	0.43	0.51	0.42	0.43	0.31	0.44	0.36	0.15	0.38	0.26
Kerala	0.62	0.81	0.77	0.76	0.59	0.69	0.2	0.09	0.09	0.12	0.03	0.025
Madhya Pradesh	0.11	0.22	0.15	0.16	0.14	0.04	0.69	0.85	0.82	0.71	0.93	0.93
Maharashtra	0.2	0.23	0.26	0.3	0.38	0.32	0.57	0.68	0.59	0.58	0.54	0.53
Meghalaya	0.59	0.79	0.74	0.67	0.77	0.75	0.97	0.96	1	0.53	1	1
Manipur	0.87	0.91	0.9	0.72	0.81	0.81	0.24	0.26	0.23	0.397	0.26	0.29
Mizoram	1	0.95	1	1	0.82	0.99	0.56	0.72	0.57	0.2	0.42	0.22

States	Women whose body mass index is below normal			Men whose body Mass index is below normal			Women who are overweight or obese			Men who are overweight or obese		
Nagaland	0.49	0.79	0.72	0.73	0.85	0.84	1	0.85	0.9	0.49	0.6	0.57
Odisha	0.42	0.33	0.26	0.54	0.4	0.37	0.21	0.65	0.61	0.45	0.61	0.64
Punjab	0.47	0.7	0.64	0.52	0.55	0.54	0.06	0	0	0.32	0.15	0.21
Rajasthan	0.32	0.38	0.31	0.53	0.48	0.45	0.88	0.94	0.95	0.98	0.87	0.95
Sikkim	0.87	1	0.98	0.82	1	1	0.17	0.26	0.21	0.12	0	0.03
Tamil Nadu	0.62	0.62	0.65	0.52	0.59	0.57	0	0.11	0.01	0	0.1	0
Telangana	0.36	0.37	0.35	0.303	0.39	0.32	0.15	0.496	0.36	0.12	0.25	0.203
Tripura	0.28	0.55	0.48	0.41	0.62	0.55	0.58	0.67	0.66	0.61	0.54	0.59
Uttarakhand	0.49	0.63	0.59	0	0.52	0.32	0.24	0.44	0.39	0.48	0.38	0.43
Uttar Pradesh	0.35	0.399	0.34	0.4	0.26	0.22	0.53	0.68	0.66	0.74	0.76	0.8
West Bengal	0.63	0.53	0.54	0.51	0.39	0.38	0.63	0.61	0.62	0.95	0.83	0.9

Source – Author's own calculation

Table -4 Normalized value of each indicator across the States of India (NFHS-4)

States	Women whose body mass index is below normal			Men whose body mass index is below normal			Women who are overweight or obese			Men who are overweight or obese		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Andhra Pradesh	0.73	0.51	0.55	0.52	0.52	0.52	0	0.15	0.01	0	0.07	0.05
Arunachal Pradesh	0.92	0.91	0.92	0.64	0.83	0.77	0.73	0.59	0.63	0.66	0.49	0.57
Assam	0.29	0.28	0.23	0.33	0.34	0.3	0.72	0.8	0.87	0.7	0.84	0.89

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Bihar	0	0.12	0.04	0.17	0.15	0.11	0.81	0.85	0.94	0.87	0.82	0.9
Chhattisgarh	0.31	0.19	0.19	0.06	0.21	0.16	0.78	0.92	0.93	0.88	1	0.99
Goa	0.81	0.44	0.67	0.66	0.59	0.68	0.34	0.11	0	0.33	0.06	0.09
Gujarat	0.28	0.04	0.17	0.16	0.05	0.14	0.41	0.63	0.42	0.66	0.67	0.61
Haryana	0.68	0.58	0.62	0.63	0.65	0.66	0.78	0.5	0.54	0.84	0.45	0.6
Himachal Pradesh	0.71	0.63	0.61	0.19	0.47	0.4	0.26	0.15	0.21	0.63	0.38	0.52
Jharkhand	0.04	0	0	0.14	0.2	0.18	0.88	1	1	0.88	0.97	0.96
Karnataka	0.41	0.37	0.43	0.39	0.46	0.46	0.51	0.58	0.44	0.57	0.55	0.51
Kerala	0.89	0.85	0.87	0.66	0.81	0.76	0.44	0	0.02	0.48	0.15	0.25
Madhya Pradesh	0.11	0.12	0.12	0	0	0	0.8	0.87	0.86	0.96	0.96	0.97
Maharashtra	0.37	0.18	0.32	0.37	0.27	0.36	0.48	0.66	0.43	0.47	0.58	0.44
Manipur	0.93	0.89	0.9	0.52	0.73	0.66	0.53	0.35	0.32	0.81	0.49	0.61
Meghalaya	0.73	0.78	0.77	0.42	0.72	0.65	1	0.83	0.92	0.98	0.94	1
Mizoram	1	0.87	0.92	0.77	0.79	0.81	0.69	0.74	0.54	0.59	0.86	0.56
Nagaland	0.63	0.8	0.76	0.45	0.74	0.65	0.91	0.71	0.74	1	0.77	0.85
Odisha	0.43	0.22	0.19	0.46	0.35	0.34	0.5	0.71	0.73	0.43	0.72	0.71
Punjab	0.9	0.74	0.79	0.64	0.68	0.67	0.48	0.03	0.09	0.44	0.2	0.28
Rajasthan	0.24	0.18	0.18	0.27	0.21	0.21	0.8	0.81	0.84	0.89	0.83	0.87
Sikkim	1	1	1	1	1	1	0.42	0.33	0.29	0.1	0	0
Tamil Nadu	0.77	0.57	0.67	0.55	0.6	0.6	0.34	0.24	0.11	0.5	0.18	0.27
Telangana	0.43	0.21	0.34	0.22	0.23	0.23	0.2	0.51	0.21	0.46	0.51	0.43
Tripura	0.41	0.52	0.5	0.45	0.51	0.51	0.81	0.73	0.75	0.94	0.65	0.76
Uttarakhand	0.31	0.25	0.25	0.18	0.07	0.07	0.68	0.74	0.73	0.86	0.9	0.9
Uttar Pradesh	0.45	0.52	0.52	0.47	0.45	0.45	0.63	0.6	0.56	0.77	0.68	0.69
West Bengal	0.55	0.36	0.41	0.16	0.39	0.39	0.55	0.64	0.59	0.86	0.83	0.83

Source – Author's own calculation

Table – 5 Ranking of 28 States of India based on the health status across the States of India (NFHS-5)

s	**women whose body mass index is below normal**			**Men whose body mass index is below normal**			**Women who are overweight or obese**			**Men who are overw or obese**		
	Urban	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**rural**	**Total**	**Urban**	**Rural**	**T**
ra Pradesh	10	11	10	18	18	18	24	18	22	18	17	1
achal Pradesh	2	2	2	3	2	1	10	13	13	13	14	1
m	16	14	14	12	10	11	6	6	6	6	6	5
	24	22	21	15	23	23	7	7	7	1	5	2

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s	women whose body mass index is below normal			Men whose body mass index is below normal			Women who are overweight or obese			Men who are overw or obese		
ttisgarh	20	21	19	11	21	20	5	4	4	4	3	2
	13	9	9	9	19	10	18	19	21	14	21	2
rat	22	24	20	21	24	22	14	8	10	7	7	7
ana	8	12	11	18	12	14	17	17	18	9	15	1
chal Pradesh	6	8	9	4	8	7	18	16	17	17	18	1
hand	23	23	22	14	20	19	4	1	2	3	4	3
ataka	12	15	13	13	14	13	16	15	16	20	13	1
la	5	5	4	5	8	6	21	21	23	21	22	2
ya Pradesh	21	21	19	22	22	22	8	5	8	7	2	4
rashtra	19	20	18	20	17	17	12	9	12	9	11	1
alaya	7	6	5	8	6	5	2	2	1	9	1	1
pur	3	4	3	7	5	4	19	17	19	15	16	1
ram	1	3	1	1	4	2	13	8	14	19	12	1
land	9	6	6	6	3	3	1	5	5	10	10	1
a	11	19	18	10	15	16	20	11	11	12	9	8
ab	10	7	8	12	9	10	24	22	25	16	19	2
sthan	17	17	17	11	13	12	3	3	3	2	5	3
m	3	1	2	2	1	1	22	17	20	21	23	2
l Nadu	5	10	7	12	8	8	25	20	24	22	20	2
gana	14	18	15	19	16	17	23	14	16	21	17	2
ra	18	12	12	16	7	9	11	10	9	8	11	9
akhand	9	9	9	23	11	17	19	15	15	11	13	1
Pradesh	15	16	16	17	21	21	15	9	9	5	8	6
Bengal	4	13	10	13	16	15	9	12	10	3	6	5

Source – Author's own calculation

Table - 6 Ranking of 28 States of India based on the health status across the States of India (NFHS-4)

States	Women whose body mass index is below normal			Men whose body mass index is below normal			Women who are overweight or obese			Men who are overweight or obese		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Andhra Pradesh	8	13	11	7	12	10	23	22	24	25	23	24
Arunachal	3	2	2	4	2	3	7	15	11	13	17	14

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States	Women whose body mass index is below normal			Men whose body mass index is below normal			Women who are overweight or obese			Men who are overweight or obese		
Pradesh												
Assam	18	17	19	14	19	18	8	7	5	12	6	6
Bihar	23	23	24	19	24	24	4	4	2	7	8	5
Chhattisgarh	17	21	20	22	22	22	6	2	3	6	1	2
Goa	6	14	8	3	11	5	20	23	25	23	24	23
Gujarat	19	24	22	20	26	23	19	13	17	13	12	12
Haryana	10	10	9	5	9	7	6	18	14	9	18	13
Himachal Pradesh	9	9	10	17	14	14	21	22	20	14	19	16
Jharkhand	22	25	25	21	23	21	3	1	1	6	2	4
Karnataka	15	15	14	12	15	12	14	16	15	16	15	17
Kerala	5	5	4	3	3	4	17	25	23	18	22	22
Madhya Pradesh	21	23	23	23	27	26	5	3	6	3	3	3
Maharashtra	16	22	17	13	20	16	16	11	16	19	14	18
Manipur	2	3	3	7	6	7	13	19	18	10	17	12
Meghalaya	8	7	6	11	7	8	1	5	4	2	4	1
Mizoram	1	4	2	2	4	2	9	8	14	15	5	15
Nagaland	11	6	7	10	5	8	2	10	9	1	9	7
Odisha	14	19	20	9	18	17	15	10	10	22	10	10
Punjab	4	8	5	4	8	6	16	24	22	21	20	20
Rajasthan	20	22	21	15	22	20	5	6	7	5	7	6
Sikkim	1	1	1	1	1	1	18	20	19	24	25	25
Tamil Nadu	7	11	8	6	10	9	20	21	21	17	21	21
Telangana	14	20	16	16	21	19	22	17	20	20	16	19
Tripura	15	12	13	10	13	11	4	9	8	4	13	9
Uttarakhand	17	18	18	18	25	25	10	8	10	8	5	5
Uttar Pradesh	13	12	12	8	16	13	11	14	13	11	11	11
West Bengal	12	16	15	20	17	15	12	12	12	8	7	8

Source – Author's own calculation

Table -7 Comparison of States across the States of India

States	Women whose	men whose	Women who are	men who are

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	body mass index is below normal		body mass index is below normal		overweight or obese		overweight or obese	
	NFHS-4	NFHS - 5	NFHS-4	NFHS - 5	NFHS-4	NFHS - 5	NFHS-4	NFHS - 5
Andhra Pradesh	11	10	10	18	24	22	24	18
Arunachal Pradesh	2	2	3	1	11	13	14	13
Assam	19	14	18	11	5	6	6	5
Bihar	24	21	24	23	2	7	5	2
Chhattisgarh	20	19	22	20	3	4	2	2
Goa	8	9	5	10	25	21	23	22
Gujarat	22	20	23	22	17	10	12	7
Haryana	9	11	7	14	14	18	13	14
Himachal Pradesh	10	9	14	7	20	17	16	16
Jharkhand	25	22	21	19	1	2	4	3
Karnataka	14	13	12	13	15	16	17	17
Kerala	4	4	4	6	23	23	22	24
Madhya Pradesh	23	19	26	22	6	8	3	4
Maharashtra	17	18	16	17	16	12	18	11
Meghalaya	3	5	7	5	18	1	12	1
Manipur	6	3	8	4	4	19	1	15
Mizoram	2	1	2	2	14	14	15	19
Nagaland	7	6	8	3	9	5	7	10
Odisha	20	18	17	16	10	11	10	8
Punjab	5	8	6	10	22	25	20	20
Rajasthan	21	17	20	12	7	3	6	3
Sikkim	1	2	1	1	19	20	25	23
Tamil Nadu	8	7	9	8	21	24	21	25
Telangana	16	15	19	17	20	16	19	21
Tripura	13	12	11	9	8	9	9	9
Uttarakhand	18	9	25	17	10	15	5	12
Uttar Pradesh	12	16	13	21	13	9	11	6
West Bengal	15	10	15	15	12	10	8	5

Source – Author's own calculation

Table -8 Specification of Model

Sr. No.	Dependent Variable	Independent Variable
1.	BMI of Female (BMIF)	WFPRF (work force participation rate for female)
2.	BMI of Male (BMIM)	WFPRM (work force participation rate for male)
3.	OWF (overweight or obese women)	WFPRF (work force participation rate for female)
4.	OWM (overweight or obese men)	WFPRM (work force participation rate for male)

Table -9 Regression Analysis and Diagnostic Tests for Model-1

Model Fit Measures							
				Overall Model Test			
Model	**R**	**R^2**	**Adjusted R^2**	**F**	**df1**	**df2**	**P**
1	0.612	0.375	0.351	15.6	1	26	< .001

Model Coefficients - BMIF19-20				
Predictor	**Estimate**	**SE**	**t**	**P**
Intercept	24.464	2.394	10.22	< .001
WPRF19-20	-0.461	0.117	-3.95	< .001

Cook's Distance				
			Range	
Mean	**Median**	**SD**	**Min**	**Max**
0.0350	0.0310	0.0316	7.05e-5	0.108

Durbin–Watson Test for Autocorrelation		
Autocorrelation	**DW Statistic**	**p**

-0.104	2.16	0.692

Collinearity Statistics		
	VIF	**Tolerance**
WPRF19-20	1.00	1.00

Normality Test (Shapiro-Wilk)	
Statistic	**p**
0.960	0.356

Table -10 Regression Analysis and Diagnostic Tests for Model-2

Model Fit Measures							
				Overall Model Test			
Model	**R**	**R^2**	**Adjusted R^2**	**F**	**df1**	**df2**	**p**
1	0.550	0.302	0.275	11.3	1	26	0.002

Model Coefficients - BMIM19-20				
Predictor	**Estimate**	**SE**	**t**	**p**
Intercept	5.714	2.4375	2.34	0.027
WPRM19-20	0.230	0.0686	3.36	0.002

Cook's Distance				
			Range	
Mean	**Median**	**SD**	**Min**	**Max**
0.0411	0.0101	0.0777	3.71e-5	0.400

Durbin–Watson Test for Autocorrelation		
Autocorrelation	**DW Statistic**	**p**
0.0680	1.78	0.542

Collinearity Statistics		
	VIF	**Tolerance**
WPRN19-20	1.00	1.00

Normality Test (Shapiro-Wilk)	
Statistic	**p**
0.962	0.383

Table -11 Regression Analysis and Diagnostic Tests for Model-3

Model Fit Measures							
				Overall Model Test			
Model	**R**	**R^2**	**Adjusted R^2**	**F**	**df1**	**df2**	**p**
1	0.528	0.279	0.251	10.1	1	26	0.004

	Model Coefficients - OWF19-20			
Predictor	**Estimate**	**SE**	**t**	**p**
Intercept	13.878	3.909	3.55	0.001
WPRF19-20	0.605	0.191	3.17	0.004

Cook's Distance				
			Range	
Mean	**Median**	**SD**	**Min**	**Max**
0.0357	0.0157	0.0539	1.55e-4	0.239

Durbin–Watson Test for Autocorrelation		
Autocorrelation	**DW Statistic**	**p**
0.0123	1.97	0.906

Collinearity Statistics		
	VIF	**Tolerance**
WPRF19-20	1.00	1.00

Table -12 Regression Analysis and Diagnostic Tests for Model-4

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Model Fit Measures					
			Overall Model Test		
R^2	**Adjusted R^2**	**F**	**df1**	**df2**	**p**
0.148	0.116	4.53	1	26	0.043

Model Coefficients - OWM19-20				
Predictor	**Estimate**	**SE**	**t**	**p**
Intercept	34.045	4.485	7.59	< .001
WPRN19-20	-0.269	0.126	-2.13	0.043

Cook's Distance				
			Range	
Mean	**Median**	**SD**	**Min**	**Max**
0.0341	0.0114	0.0670	8.21e-6	0.344

Durbin–Watson Test for Autocorrelation		
Autocorrelation	**DW Statistic**	**p**
-0.0823	2.09	0.798

Collinearity Statistics	
VIF	**Tolerance**
1.00	1.00

Normality Test (Shapiro-Wilk)	
Statistic	**p**
0.966	0.474

Figure- 1

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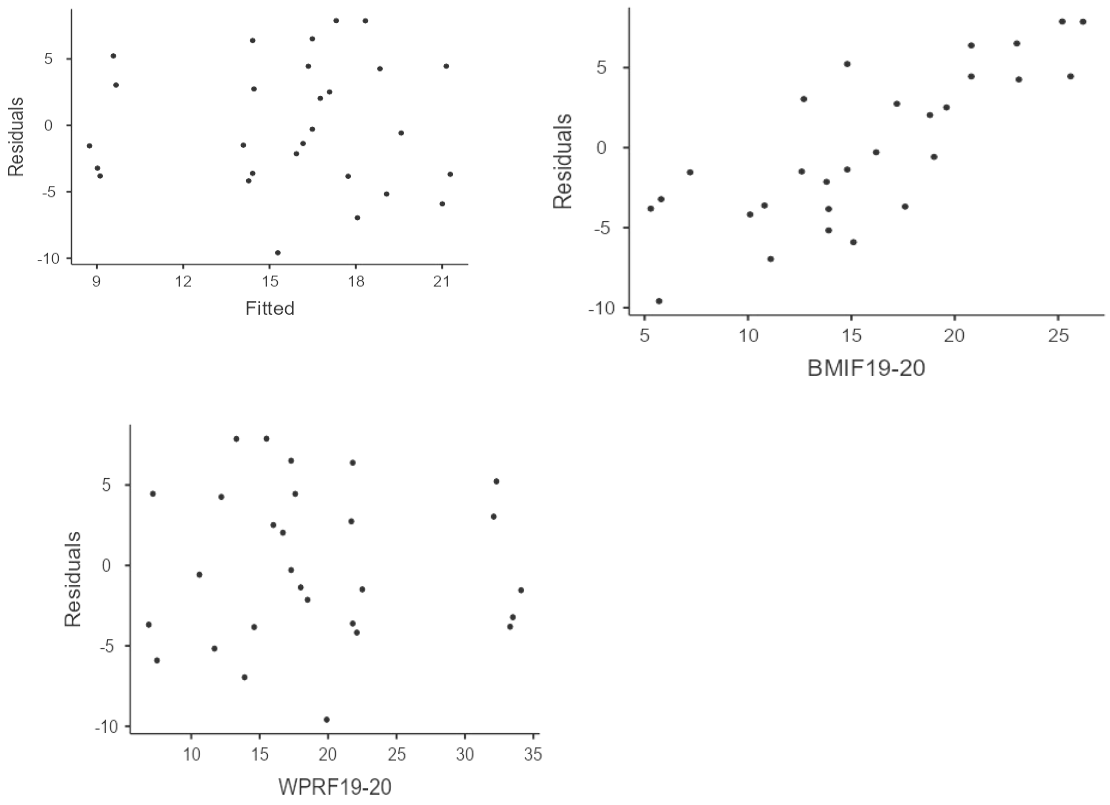
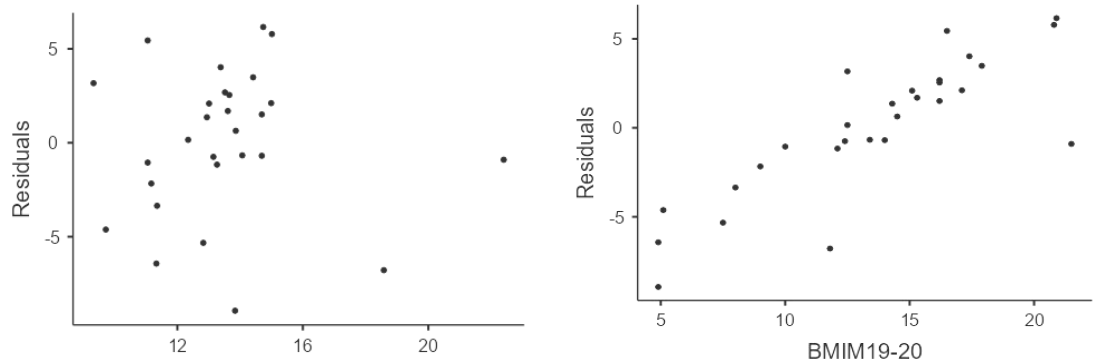


Figure- 2



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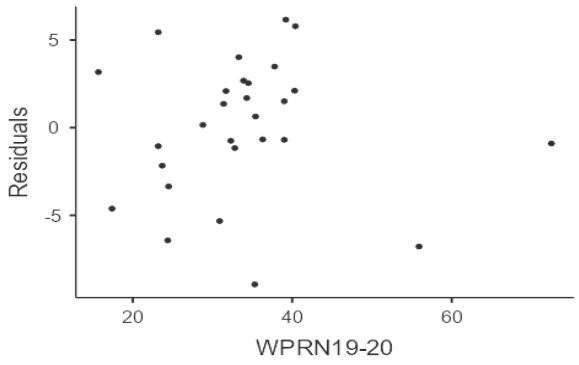
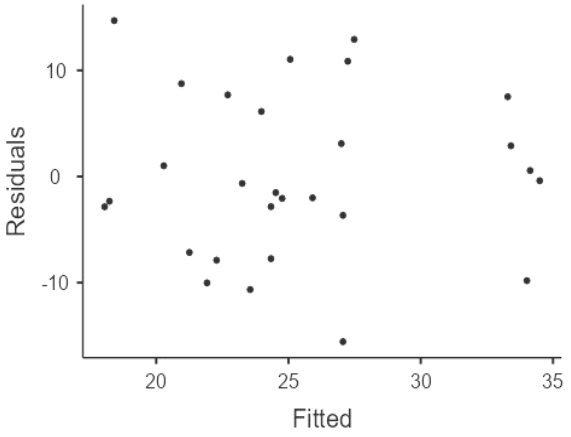
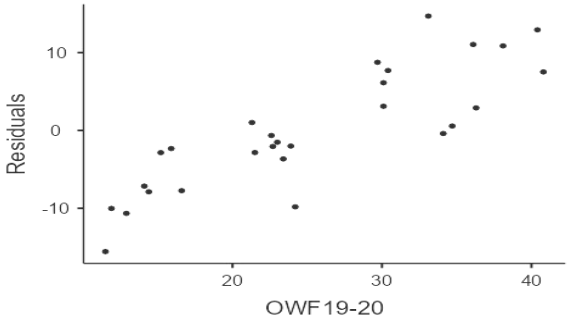


Figure- 3





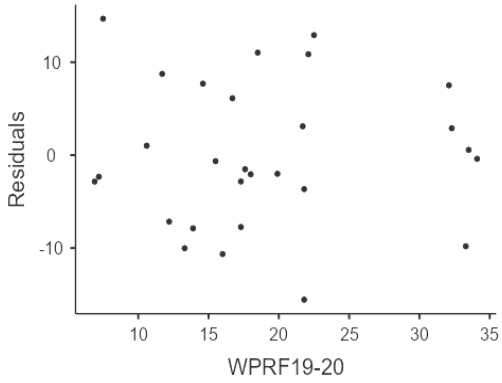


Figure-4

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