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Impact of Diet on the Nutritional Status of Adults in Perspective to Urban Area of Katihar, Bihar

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Introduction:

As the world is becoming one small village because of globalization there is no aspect of our lives that has not been affected by the cultural mingling. Our kitchens are flourishing with food from all over the world whether it is Continental, Chinese, Thai or Italian. There are many fast food outlets that are popping up, things are available on digital platform and foods can be ordered with just one phone call. With increased accessibility and purchasing power consumption of fried foods, fast foods and meat products have drastically increased (Damodaran K., 2018). Eating out has increased immensely and families are purchasing foods that were once cooked at home. An increasing number of young people have higher disposable incomes than their older counterparts and tendency to spend money rather than to save it. Ready to eat foods which includes frozen foods, packaged foods and quick fast food meals at quick service restaurants have seen a huge growth in the recent times (Madhavapathy and Dasgupta., 2015). Exploring dietary patterns is a burgeoning field within nutritional science. In the expansive Indian Migration Study, researchers identified five principal diets among a vast sample of adults across India, labeled as follows: Rice & low diversity, Rice & fruit, Wheat & pulses, Wheat, rice & oils, and Rice & meat (Shridhar et al., 2014). Despite the vast majority of India's food being produced domestically, these categorized food groups represent only a minimal portion of the diet. Amidst India's ongoing nutrition transition, a significant segment of the population adheres to the Rice & low diversity diet (Dipnail et al., 2016). Alarming, a considerable percentage of pregnant women—ranging from fifty one percent to eighty three percent—consume micronutrients like iron, vitamin A, riboflavin, vitamin C, and folic acid at levels below half the recommended daily allowance. This issue of low micronutrient intake is notably less prevalent among adult men and women who are neither

pregnant nor lactating (Shankar et al., 2017). Among pre-school children, forty nine percent to sixty percent have adequate protein and calorie intake, a contrast to the sixty three percent of the adult men and seventy one percent of non-pregnant/non-lactating women meeting these nutritional needs. There is a huge difference between the dietary intake of urban residents and rural residents. Rural people consume simple food that is rich in dietary fiber and low in saturated fat. Prevalence of non-communicable diseases are increasing, large number of urban people are suffering from obesity, diabetes and cardiovascular disorders. This is attributed to the dietary shift associated with sedentary lifestyle (Shariful Islam et al., 2013). The rapid urbanization process has also led to a workforce transition from agriculture to the services sector, contributing to a decrease in the general physical activity levels among the population. In rural Bihar problem of under nutrition is prevalent. India is fighting with dual burden of malnutrition on one side people are suffering from obesity and on the other hand people are underweight. This is mainly due to lack of variety in the diet. Rural diet is mainly cereal based and confined to two meals a day. The consumption of essential food groups like milk and dairy products, pulses, green leafy vegetables, other vegetables, and fruits fell significantly short of adequate levels. Data from the **NNMB rural surveys (2011–2012)** indicated a 35% incidence of underweight (body mass index (BMI) Z-scores below -2 SD) and a mere 2.2% occurrence of overweight and obesity among adolescents (Shankar et al. 2017). According to the NNMB rural survey report 2011–2012 chronic energy deficiency affected thirty five percent adults irrespective of gender. Recent data suggests increasing trends in abdominal obesity irrespective of gender (Shankar et al. 2017).

Literature Review :

Study conducted by Green et al., 2016, Popkin et al., 2001 found evidence of changing dietary pattern of Indians overtime as it is transitioning from traditional diets to more western ways of eating and a concomitant epidemiological transition. Studies conducted have shown that twenty-nine dietary patterns predominantly vegetarian food groups are still prevalent in India. These diets were based on fruits, vegetables pulses and cereals (mostly rice), with added dairy products, meat and eggs in many cases. The most widely used food groups were vegetables, cereals, fruits, meat, pulses and dairy products respectively. Diets with high amounts of animal protein, sugar, sweets and high fat diet were associated with high body mass index (BMI) whereas diets rich in fruits and vegetables were associated with lower body mass index (BMI) (Green et al., 2016 And Satija et al., 2015).

Satija et al. (2015) conducted a study to examine the dietary pattern and its correlation with obesity. The research involved 7067 participants (4123 men and 2944 women) from factory settings in Lucknow, Nagpur, Hyderabad, and Bangalore. Anthropometric measurement was taken and correlated with the BMI. The frequency of consumption of various food items was assessed using an interviewer-administered semi quantitative FFQ, covering 184 commonly consumed food items in India. Socio-economic status of the family played an important role in identifying the dietary pattern of the respondents. Respondents with high income consumed more fruit, protein and savoury foods. Study showed a negative relationship between dietary diversity and obesity.

Anand (2011) studied the various factors influencing the food choices in India. He suggested that urbanization, sedentary lifestyles, rising incomes, and changing eating habits have contributed to a shift towards fast food and snacks, leading to concerns about obesity, particularly among children. Surveys indicate a significant portion of the population consuming junk food, contributing to obesity-related health issues such as diabetes, cardiovascular disease, and hypertension. The organic food industry aims to promote natural, additive-free, and organic foods to address health and environmental concerns. However, the rise in global obesity and ethical

consumerism raises questions about corporate social responsibility in the food industry. The trend towards energy-dense, nutrient-poor foods, coupled with reduced physical activity, has led to epidemics of obesity and lifestyle diseases

Bose et al. (2022) studied the different factors leading to a surge in the prevalence of obesity and metabolic disorders. He tried to identify unhealthy dietary pattern and behaviours that are key contributor of obesity and other metabolic disorders. He found that unhealthy dietary patterns characterized by insufficient dietary fiber intake, coupled with excessive calorie consumption, saturated fat, and dietary salt, alongside sedentary behaviors, as predominant contributors. The authors underscored the transformative impact of urbanization, industrialization, and globalization on dietary habits and lifestyle choices, precipitating a notable uptick in obesity prevalence and related health ailments, even within rural enclaves of India. Employing a cross-sectional approach, the researchers analyzed a cohort comprising 150 obese males aged between 20 to 50 years, with a Body Mass Index (BMI) falling within the range of 25 to 30 kg/m², randomly sampled from both rural and urban precincts of the Hooghly district in West Bengal, with an equal representation of 75 participants from each setting. Comprehensive data encompassing background information, physical activity metrics, and dietary records were meticulously gathered and subjected to scrutiny. Anthropometric assessments, including measurements of height, body weight, BMI, waist circumference (WC), waist-to-height ratio (WHtR), and waist-to-hip ratio (WHR), were conducted to elucidate variations between the two cohorts. Analysis revealed notable disparities (p value < 0.05) in the consumption patterns of diverse food groups, calorie intake, and physical activity levels across rural and urban settings. A substantial proportion of participants in both urban (58.7%) and rural (52%) locales fell short of meeting the minimum global recommendations for physical activity across work, travel, and recreational domains. However, rural males exhibited a significantly higher mean duration spent in travel and recreational pursuits compared to their urban counterparts. Anthropometric assessments unveiled significantly elevated levels of body weight, BMI, and WHR among urban participants relative to their rural counterparts (p value < 0.05). Remarkably, both rural and urban cohorts manifested a WHtR of 0.57, indicating heightened cardio-metabolic risks for both demographic segments.

Khanna and Kaushik (2012) reported that urbanization, modernization and privatization has shifted the working dynamics of the family. Despite economic prosperity stress level has increased multifold. These factors have interplayed an important role in the dietary shift from traditional Indian food to westernized foods. This has led to an increase prevalence of metabolic disorder particularly among the urban residents. This transition, marked by a shift towards diets rich in fat and calories coupled with heightened mental stress and sedentary behaviors, has exacerbated the prevalence of lifestyle diseases such as obesity, diabetes, hypertension, coronary heart disease, metabolic syndrome, and cancer across India over recent decades.

Methodology : The study involved 300 respondents. Information was gathered using questionnaires, observations, and interviews whatever feasible. Data were collected randomly from individuals, and the results were tabulated and analyzed using appropriate techniques to ensure the scientific rigor of the research.

Sample Size : The Study included 150 adult men and 150 adult women in the age group of 30–60 years of Katihar District. The subjects were selected using random sampling method. The sample size was determined on the basis of estimated total men and women in the age group of 30–60 years.

Anthropometric measurements– Included the name, age, gender Included height, weight, hip circumference, waist circumference. Weight of the respondents was measured by using Dr. Trust, Inspire personal digital electronic weighing machine, height was measured using the prime surgicalsstandiometer, waist circumference and hip circumference was measured using measuring tape.

Body mass index (BMI)

BMI for adults serves as an indicator of their nutritional status. It is calculated by dividing a person's weight in kilograms by the square of their height in meters (kg/m^2). Height and weight measurements are essential for BMI calculation, providing insights into potential overnutrition or undernutrition. In this study, BMI was computed by multiplying the height in meters squared by the weight in kilograms (kg). The resulting values were compared against standard classification criteria as prescribed by the Indian Council of Medical Research.

Table no. 1: Classification of BMI for Indians as prescribed by the ICMR

BMI (ICMR)	STATUS
<18.5	Under weight
18.5 – 22.9	Normal weight
23.0 –24.9	Overweight
≥ 25	Obese

Waist Hip Ratio

Waist circumference was measured by encircling a tape measure around the narrowest part of the waist, positioned just above the belly button. Subsequently, hip circumference was determined by gauging the circumference around the widest area of the buttocks, representing the broadest portion of the hips. Waist-to –hip ratio is a swift measure of abdominal obesity; it reflects individual's propensity towards metabolic disorders. Cut off used was prescribed by **Sruti et al., 2023**.

Table no. 2: Classification of waist-to-hip ratio for Indians

Health risk	Women	Men
Low	≤ 0.80	≤ 0.95
Moderate	0.81 – 0.85	0.96 – 1.0
High	≥ 0.86	≥ 1.0

Data Analysis

Microsoft Excel 2021 was used for data analysis. Linear regression was used to predict the relationship between the body mass index and waist-to-hip ratio at 95% confidence level. P-value < 0.05 was used to test the significance of the hypothesis.

Results& Discussions :

Respondent's characteristics are mentioned in the table no 3(a). We can see that the age of the respondents ranged from 40.03 years to 41.47 years. Average height of the male respondent was more when compared to the average height of the female respondents, average weight of the male respondent (66.59 kg) was more when compared to the average weight (59.13 kg) of the female

respondents. Similarly, the body mass index (BMI) of male respondents was $24.51 \pm 3.42 \text{ kg/m}^2$ when compared to the body mass index of female respondents. Average waist circumference and hip circumference for female respondent was more when compared to the male respondents. This clearly suggests the risk of abdominal obesity is more among female respondents when compared to the male respondents. The ever-increasing trend in abdominal obesity worldwide has gathered global attention. Obesity is termed as potential global public health problem, 2 billion adults, representing 44 percent of the global adult population is suffering from obesity. Over 70 percent of them reside in low-income or middle-income countries (Schneider et al., 2020). Obesity refers to the excessive accumulation of fat in the body, and the pattern of fat distribution play a crucial role in determining metabolic risk. Based on the location of the fat, there are two types of body forms which the obese individuals generally exhibit: gynecoid or pear shape (fat accumulation in the lower body such as the hips and thighs) and android or the apple shaped (fat accumulation in the upper body such as the visceral or the abdominal region) (Gestaetal., 2007). Abdominal or visceral form of obesity is considered dangerous as it predisposes the risk of metabolic disorders. Body mass index is used to measure obesity. This index has limitations as it is not able to distinguish between overweight due to obesity and muscular hypertrophy. It fails to tell the type of obesity. Abdominal or central obesity is defined as having a waist circumference of more than 80cm in women and more than 94 cm in men. It is a strong predictor of cardiovascular disease, type 2 obesity and other metabolic disorders (Chaudhary and Sharma., 2023).

In our study we found that the prevalence of obesity among the male respondents was 40% and 33.33% in the females, 42% of the male respondents and 20.67% of the female respondents were overweight. Only 2% of the male respondents and 8% of the female respondents were found to be underweight whereas 30% of the male respondent and 38% of the female respondents were normal. There is an increase in the purchasing power, convenience items are increasing in the household, thereby decreasing the physical work. Most of the respondents were sedentary and did not do exercise. In our study we found that female respondents are more prone to develop abdominal obesity, 97.3% of the female respondents in high health risk as their waist-to-hip ratio was more than 0.86. All the male respondents had normal waist-to-hip ratio. Abdominal obesity increases the chances of metabolic disorders as the fat deposited in the central region leads to insulin resistance. Venkatrao et al., (2020) analysed 1,00,531 adults from a nationwide randomized cluster survey and classified them using the body mass index. They found the prevalence of obesity 40.3% with zonal variations, people from South India are more prone to develop obesity when compared to the eastern parts of India. They found that women are more susceptible to develop obesity. They reported high prevalence of obesity in the urban region when compared to the rural area. Studies have reported that obesity undermine the socio-economic productivity of individuals. These findings were consistent with our study. We tested the hypothesis that female respondents are more prone to abdominal obesity when compared to the male respondents. To test this, we ran one-way anova to see if there is any difference in the mean value of waist-to-hip ratio of male respondents and female respondents. we observed a significant difference between the average WHR of male respondents to the WHR of female respondents as the p-value at 95% confidence level was 0.014. Thus, the hypothesis holds true. There are several studies to validate this result Gupta et al., 2023 reported the prevalence of abdominal obesity 13.85% among male respondents and 57.71% among female respondents. They found that chances of abdominal obesity is increased with age, sedentary lifestyle, increased wealth index, increased educational status and with residing in urban area. In our study we found a very high prevalence rate of abdominal obesity among female respondents (97.33%), these females are at increased risk of metabolic syndrome. Central adiposity is a better indicator for predicting

cardiometabolic risk (Prasad et al., 2011). Similar gender differences in the prevalence of high-risk waist-to-hip ratio were reported by Prasad et al., 2020, gender differences in waist-to-hip ratio are more pronounced in developing countries (Deepa et al., 2007). Priyadharsini et al., (2017) reported higher waist-to-hip ratio in underweight and normal women this was consistent with our findings.

In our studied we used linear regression model at 95% confidence level to analyse if we can predict the waist-to-hip ratio by knowing the body mass index. The linear regression model is presented in table no. 3(d). A positive and moderately strong relationship exist between the body mass index and waist-to-hip ratio of the male respondents. 9.3% of the variance in waist-to-hip ratio can be accounted for by the body mass index measure. There is a linear relationship between the body mass index and waist-to-hip ratio. The waist-to-hip ratio of the male respondents can be predicted if the body mass index is known to us by putting in the formula $y = -0.0022837 \times x - 0.93542$ where x is the body mass index and y is the waist-to-hip ratio. Similarly, we tested the linear regression model for female respondents, to see if we can predict the waist-to-hip ratio of female by knowing the body mass index. The linear regression model is presented in the table no. 3(e). Positive correlation of 0.262 exists between the body mass index and waist-to-hip ratio of the female respondents. Only 6.9% variance in waist -to-hip ratio can be explained by body mass index. Rest is affected by variable factors. Using the body mass index the waist-to-hip ratio can be predicted by using the formula $y = -0.0014 \times x - 0.91976$, where x is the body mass index and y is the waist-to-hip ratio. Thus, the hypothesis body mass index is a significant variable that affects the waist-to-hip ratio of the respondents holds true as the $\alpha < 0.05$.

Table no. 3(a): Respondent's characteristics and coremeasures

Male	Age	Height (cms)	Weight (Kgs)	BMI (Kg/m ²)	WC (cms)	HC (cms)	WHR
Average± SD	41.47±9.35	165 ± 8.34	66.59 ± 9.23	24.51 ± 3.42	84.21 ± 5.42	95.84 ± 6.86	0.9 ± 0.03
Female							
Average± SD	40.03 ± 9.10	157.67 ± 7.18	59.13 ± 9	23.89±4.09	88.27±6.93	99.70±8.95	0.9 ± 0.02

Table no. 3(b) Classification of respondents based on body mass index

BMI (ICMR)	STATUS	Number of male respondents	Percentage	Number of female respondents	Percentage
<18.5	Under weight	3	2	12	8
18.5 – 22.9	Normal weight	45	30	57	38
23.0 –24.9	Overweight	42	28	31	20.67
>=25	Obese	60	40	50	33.33

Table no. 3(c): Classification of respondents based on the waist-to-hip ratio

Health risk	WHR for male	Number of male respondents	Percent age	WHR for female	Number of female respondents	Percent age
Low	≤0.95	150	100	≤0.8	4	2.67
Moderate	0.96 – 1.0	0	0	0.81 – 0.85	0	0
High	≥1	–	–	≥0.86	146	97.33

Table no: 3(d): Anova table showing difference between the WHR of male and female respondents

SUMMARY				
Groups	Count	Sum	Average	Variance
WHR Male	150	131.918	0.87945	0.00065
WHR Female	150	132.937	0.88625	0.00048

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.00346	1	0.00346	6.14987	0.01369	3.87285
Within Groups	0.16789	298	0.00056			
Total	0.17136	299				

Table no. 3(e): Linear regression model between the body mass index and waist-to-hip ratio of male respondents

Regression Statistics	
Multiple R	0.30629925
R Square	0.09381923
Adjusted R Square	0.08769639
Standard Error	0.02435074
Observations	150

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	0.00909	0.00909	15.3228	0.00014
Residual	148	0.08776	0.00059		
Total	149	0.09684			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.93542446	0.01444	64.7936	2E-110	0.9069	0.96395	0.9069	0.96395
BMI kg/m2 Male	-0.0022837	0.00058	-3.9144	0.00014	-0.0034	-0.0011	-0.0034	-0.0011

Table no. 3(f): Linear regression model between the body mass index and waist-to-hip ratio of female respondents

Regression Statistics	
Multiple R	0.26253
R Square	0.06892
Adjusted R Square	0.06263
Standard Error	0.02114
Observations	150

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	0.0049	0.0049	10.9552	0.00117
Residual	148	0.06615	0.00045		
Total	149	0.07105			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.91976	0.01027	89.5519	8E-131	0.89946	0.94005	0.89946	0.94005
BMI kg/m2 Female	-0.0014	0.00042	-3.3099	0.00117	-0.0022	0.0006	-0.0022	0.0006

Conclusion :

The prevalence of obesity has increased overtime 40% of the male respondents and 33.33% of the female respondents were obese. There was no significant difference in obesity with respect to gender. Risk of abdominal obesity was significantly higher among the female respondents when compared to the male respondents. Ninety-seven point three three percent of the female respondents were found to be abdominally obese whereas none of the male respondents showed health risk as the waist-to-hip ratio was ≤ 0.95 . Early detection of risk of metabolic disorders can be predicted by measuring the waist-to hip ratio. We successfully predicted this formula.

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