

Food consumption pattern and Body Mass Index assessment along rural-urban interface of the South Indian mega city of Bangalore

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■ **ABSTRACT** : Food consumption pattern are predictors of health and nutritional status. Bangalore is one of the rapidly urbanizing South Indian megacity with a population of 11 millions. Study highlights gradient changes with reference to food consumption pattern and Body Mass Index (BMI) among households in the rural-urban interface of Bangalore. A total of 300 middle income households were selected by purposive random sampling technique. Standardized schedule was used to collect information on food consumption pattern and BMI using standard protocols. Consumption of energy dense foods was significantly more than adequacy. Average dietary diversity score was less than 50 per cent which is indicative of routinely consumption of only few food groups among households. Fried (51.4%) and Ready-to-eat (51.0%) foods consumption was more frequent in rural. Prevalence of overweight (24.5%) and obesity was more in urban (7.1%). Overall, incidences of overweight and obesity were more compared to underweight. This reveals, that there is a need for intervention and promotion of diversified and functional foods to address overweight and obesity, which are the root causes for non-communicable diseases in order to protect health and nutritional status of individuals along rural-urban interface of Bangalore.

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Increased income and globalization of food is changing dietary patterns. Asia, with some exceptions, has undergone substantial economic growth in recent decades and this is reflected in rising incomes and increased consumer purchasing power (Kelly, 2016). Hence, dietary patterns are changing both in urban and

rural areas, as well as among rich and poor households. Urbanization refers to the mass population migration from rural settings to urban (Kuddus and Rahman, 2015). Rapid growth in the urban population, increasing migration rates to urban areas, mechanization in rural and tertiarization in urban areas led to a shift towards a

sedentary lifestyle and decreased energy expenditure (Misra *et al.*, 2011).

Consumption of specific food items and their combinations in daily diet is referred as food consumption pattern and are predictors of health and nutritional status. The term nutrition transition has been used to describe the large shifts in diet and activity patterns, which are reflected in nutritional outcomes (Popkin, 2006). The dietary changes that characterize the “nutrition transition” include both quantitative and qualitative changes in the diet. Urbanization is one important factor for changing dietary patterns and leading to nutrition transition. Food intake, dietary diversity and processed foods consumption are important components influencing nutritional status. Body Mass Index is the one of the popular anthropometric tool to assess nutritional status of the subjects. The body mass index, or BMI (weight in kilograms divided by the square of the height in meters), is recommended by the World Health Organization as the most useful epidemiological measure of obesity. An excess amount of body weight has been associated with increased risk of cardiovascular disease, diabetes, certain types of cancer, mortality and the obesity associated comorbidities are of major public health concerns (Hongyu *et al.*, 2013).

Bangalore is one of the rapidly urbanizing south Indian megacity with population of 11 millions and its growing urbanization continues to influence on surrounding localities. The present study highlights gradient changes with reference to food consumption pattern and BMI among households, to understand the current scenario at the localities with different urbanization level along rural-urban interface of Bangalore. This will further facilitate to interlink these findings with urbanization and helps to address future health and nutritional status of the population.

■ RESEARCH METHODS

Selection of study locale and methodological approach involved following steps:

Selection of localities:

Rural-urban interface of the Bangalore (two transects) was defined as a common space for interdisciplinary research. The northern transect (N-transect) is a rectangular strip of 5 km width and 50 km length, the lower part of this transect cuts into urban

Bangalore, and the upper part contains rural villages. The Southern transect (S-transect) is a polygon covering a total area of 300 km². Rural-Urban interface was further divided into three sub regions *viz.*, Rural, Transition and Urban areas based on the simplified Survey Stratification Index (SSI) by following the logic of the Urban-Rural Index which considered distance to the city centre (Vidhana Soudha) and percentage of built-up area (Hoffmann *et al.*, 2017). This classification of regions, formed basis for selection of 300 middle income households based on purposive random sampling, in the rural-urban interface of Bangalore.

Data collection:

A schedule or questionnaire was developed and pretested in selected localities. The necessary changes were incorporated to standardize it. Information on food intake, dietary diversity, frequency of consumption of processed foods and Body Mass Index (BMI) was collected using standard protocols.

Household food consumption:

Household food consumption is the total amount of food available for consumption in the household, generally excluding the food taken outside unless prepared at home. It serves as a direct indicator of food security. Data on household consumption of foods for 30 days was recorded namely cereals, pulses, green leafy vegetables, other vegetables, fruits, milk and milk products, fats and oils, sugar and Jaggery (a coarse dark brown sugar made in India by evaporation of the sap of palm trees. Based on adult consumption unit (ACU) according to age and sex developed by Indian Council of Medical Research (ICMR) the food intake per day by individuals was assessed (Singh *et al.*, 2015). Further they are compared with Recommended Dietary Allowances (RDA) for Indians given by ICMR, to calculate per cent adequacy of the food groups consumed.

Assessment of dietary diversification:

Dietary diversity is the sum of number of different food groups consumed over a given reference period (Hoddinott and Yohannes, 2002). It is considered as a proxy to household food security. Dietary diversity scores were calculated by summing the number of food groups consumed by the household members over the 24-hour recall period. The data on dietary diversity scores was

collected using the structured questionnaire by following FAO guidelines and expressed in terms of percentage values (Gina Kennedy *et al.*, 2010).

Frequency of processed food consumption:

Information on the frequency of consumption of processed foods from the respondents was collected, *i.e.* daily, weekly and monthly. Based on how frequently foods were consumed, it was expressed in terms of weighted average (an average resulting from the multiplication of each component by a factor reflecting its importance).

Body mass index:

Anthropometry denotes the pattern of growth and physical status of the body. Nutritional anthropometry is measurement of human body at various ages and levels of nutritional status. The anthropometric measurements *viz.*, height (ht) and weight (wt) were measured for adult household members at the time of survey. Body Mass Index (BMI) was calculated and compared with Asian standards for BMI classification (Girdhar *et al.*, 2016).

Statistical analysis:

Information collected on all the aspects were

analyzed with suitable statistical tests to elicit the results based on study objectives. Standard ‘t’ test was applied for comparison of mean food intake values with reference standards. Chi-square test was used to test significant difference across rural-urban gradient for classification of BMI. Simple regression analysis was conducted to analyse factors affecting BMI.

RESEARCH FINDINGS AND DISCUSSION

Results were structured under following headings:

Food consumption:

Cereals consumption among female along the rural-urban gradients was ranged from 129 per cent in rural to 107 per cent in urban areas, which was found to be significantly more than the RDA. However, among male it was only in rural, where cereals consumption was more than adequate (116%). Inadequate consumption of pulses was indicated by significantly lower consumption among all study areas. Sugars, oils and fat consumption was significantly more than adequacy in all study areas. Oils and fat consumption was highest in transition area whereas sugars in urban locations. Adequate consumption of milk and milk products was observed

Food groups	Gender	RDA	Intake						P Value
			Rural		Transition		Urban		
			Adequacy (%)	't' Test	Adequacy (%)	't' Test	Adequacy (%)	't' Test	
Cereals	M	375	116	3.20*	108	1.74 ^{NS}	97	1.32 ^{NS}	0.19
	F	270	129	5.12*	121	3.81*	107	2.69*	
Pulses	M	75	71	7.60*	76	6.22*	81	5.32*	0.82
	F	60	89	2.15*	77	6.23*	81	4.48*	
Oil and Fats	M	25	144	4.82*	167	7.87*	162	8.38*	6.71E
	F	20	143	5.59*	167	7.90*	161	8.70*	
Sugar	M	20	171	5.91*	194	10.23*	216	10.30*	0.44
	F	20	137	3.74*	155	6.48*	173	7.94*	
M & M products	M	300	70	7.73*	82	3.25*	92	1.29 ^{NS}	0.35
	F	300	56	14.02*	65	7.36*	74	5.46*	
Roots and Tubers	M	200	23	90.86*	15	108.96*	13	111.98*	0.08
	F	200	18	115.54*	12	137.96*	11	209.54*	
Vegetables	M	200	54	21.71*	55	21.31*	58	19.73*	0.90
	F	200	43	33.50*	44	30.70*	46	34.39*	
Green Leafy Vegetables (GLF)	M	100	33	31.73*	28	51.05*	29	45.64*	0.62
	F	100	26	47.57*	22	61.20*	23	60.34*	
Fruits	M	100	79	4.77*	80	6.43*	93	1.50 ^{NS}	0.57
	F	100	63	13.01*	64	13.40*	74	6.73*	

*indicates significance of value at P=0.05

NS= Non-significant

only among urban male, whereas among other areas it was found to be inadequate and least was observed for rural female (56%). Roots, tubers and green leafy vegetables consumption was though more adequate in rural compared to other study areas it was found significantly less than RDA. Other vegetables and fruits consumption was more in urban compared to transition and rural areas, but it was significantly insufficient by not meeting the RDA (except for fruits consumption among urban male =93%).

Dietary diversification score (DDS):

Average dietary diversity score was more in urban with 39.4 per cent, followed by rural (38.6%) and transition (37.5%) areas, indicating more diversified foods consumed in urban and least was in transition (Fig. 1).

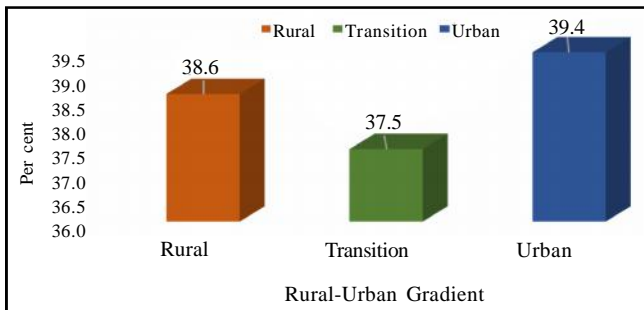


Fig. 1 : Dietary diversification score (DDS) of households

Frequency of processed food consumption:

Findings revealed that, compared to other processed foods, the consumption of bakery foods was more common, along the rural-urban gradient. It was surprising to note that in rural, fried (51.4%) and ready-to-eat (51.0%) foods consumption was more frequent compared to transition (fried=47.7%, RTE=47.9%) and urban (fried=47.3%, RTE=35.4%). Chats consumption was more frequent in urban (40.0%).

Body mass index (BMI):

Body mass index assessment revealed that, prevalence of underweight was more in rural (14.2 %), followed by transition (9.1%) and urban (6.6%) areas. Overweight (24.5%) and obesity prevalence was (7.1%) more in urban. Individuals belonging to pre-obese category were almost equal in both transition (23.7%) and urban (23.4%). It was surprising to note that, in rural over-nutrition depicted by overweight and pre-obese

were more compared to under-nutrition (Fig. 2).

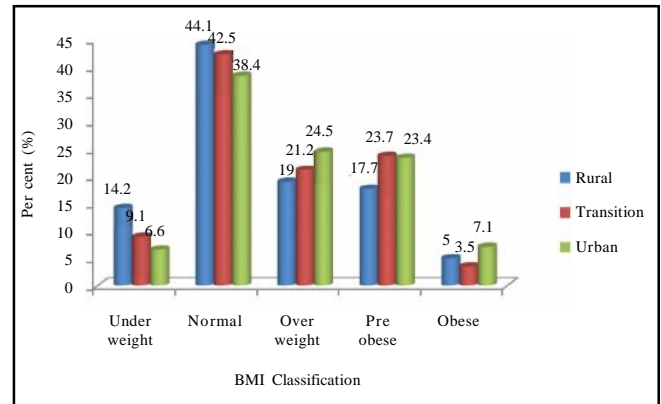


Fig. 2 : Classification of household members based on Body Mass Index (BMI)

Factors affecting BMI:

Variables considered to analyse factors influencing BMI were age, Mid Upper Arm Circumference (MUAC), Waist Hip Ratio (WHR), cereals intake, rural-urban gradient (rural, transition, urban), transects (north and south), gender (men and women). Results revealed that, age has negative impact on BMI, however it was non-significant. Direct positive influence of MUAC on BMI was noticed. Waist Hip Ratio which indicates central obesity exhibited statistically significant effects. Intake of cereals was also positively associated with BMI. Urban living and south transect have significant and positive association with BMI. Among the gender, women have significantly more tendency to get increased BMI compared to men.

Food consumption:

In rural and transition areas, most of the households were dependent on agriculture. Finger millet is one of the important crop produced in the region and also the staple food of many households. Apart from this, most of rural households were beneficiaries of the Public Distribution System (PDS) and are entitled to 5 kilograms of cereals per person per month under subsidized prices, which makes cereals more accessible and affordable. Such beneficiaries were also prevalent among transition and urban households, however it was in small number. In the rural-urban gradient of Bangalore, rice and finger millet are staple foods, which resulted in more intake of cereals than RDA. Increasing price and lack of nutrition knowledge regarding intake of pulses restricted

its consumption. Redgram is the predominant pulse consumed among the study areas. Though many of the households had livestock especially cows for milking, consumption of milk and milk products was less in rural locations. Milk was sold to dairies for the income purpose and little share was used for household consumption. Consumption of roots and tubers was more in rural, may be due to their storage stability, whereas in urban the diversified vegetables group (other vegetables) were consumed. Green leafy vegetables consumption in rural was more due to local availability and own farm productions. According to Global panel, 2017, compared to rural settings, urban food environments are generally characterized by better availability of fresh fruit and vegetables and greater diversity of other nutrient-rich foods. This is due in part to urban consumers having higher average incomes, creating a greater demand for perishables. Another factor is the increasing availability of refrigeration and supermarkets, particularly in middle-income countries. These reasons may be correlated to more adequate consumption of other vegetables and fruits

at urban areas in the present investigation. Proctor and Berdegué (2016) reported that, increasing income and globalization of food is changing dietary patterns. Much of the structural change concerns the rapid increase of consumption of livestock products (meat, milk, and eggs), vegetable oils and sugar as sources of food energy. These statements correlate with present findings, however, meat, milk and egg consumption was less, though majority belonged to non-vegetarian food habit. This may be attributed to cultural believes and increasing prices of this particular food groups might have restricted its consumption, especially in rural.

Dietary diversity score:

The consumption of wide variety of foods ensures adequate intake of micro nutrients essential for nutrition adequacy. Promoting dietary diversity is one of the strategies to alleviate nutritional problems that occur due to inadequate intake of micronutrients and nutrition insecurity. Among the study areas, average dietary diversity score was less than 50 per cent which is

Table 2 : Frequency of processed food consumption (n=300)

Study area/ Processed Foods	Frequency of processed food consumption							Wt. average (%)
	Daily	Weekly (%)			Monthly (%)			
		Once	Twice	Thrice	Once	Twice	Thrice	
Rural								
Chats	17	12	21	19	4	8	0	34.4
Bakery foods	5	1	5	3	22	10	4	57.1
Street/rest.	3	18	18	10	13	29	4	24.0
Fried	5	13	20	22	13	8	1	51.4
RTE	0	11	13	5	16	20	2	51.0
Transition								
Chats	2	8	13	12	21	16	1	38.7
Bakery foods	23	13	19	13	5	11	0	60.4
Street/rest.	5	7	11	3	18	17	4	33.7
Fried	4	11	19	10	19	24	0	47.7
RTE	6	11	18	19	13	10	2	47.9
Urban								
Chats	0	18	6	6	24	22	2	40.0
Bakery foods	26	15	22	11	2	5	3	63.6
Street/rest.	5	2	3	4	22	18	6	26.6
Fried	4	18	13	1	25	21	9	47.3
RTE (Ready to eat)	3	8	10	18	9	13	4	35.4
F test (between processed foods)								16.65**
p value								0.0006
F test (between rural-urban gradient)								0.47 ^{NS}
p value								0.63

NS=Non-significant

indicative of consumption of only few food groups among households. These are mainly, cereals, pulses, milk (mainly in terms of tea or coffee), oils and sugars. According to Global Panel (2017) many foods are often available at a lower cost in urban environments, because of economies of scale due to larger customer bases, better supply infrastructure and increased competition resulting from multiple suppliers. But, evidence suggests that income growth enables urban consumers to access more food to there by lead to increase in dietary diversity. Selection of only middle income households in present study may be the reason for least difference between DDS along rural-urban interface. A study conducted in South African towns by, Chakona and Shackleton (2017) reported that, the peri-urban populations had limited dietary intake and were more food insecure because of high levels of poverty, unemployment, and lack of land. Peri-urban dwellers are therefore more sensitive to changes in incomes and food prices because they lack safety nets to absorb income or price shocks as they purchase more, rather than growing their own food. This compromises dietary diversity as they have limited access to diverse foods. In our study similar observations were made with respect to DDS of transition area. It is also considerable point that, DDS takes into account of a day's menu and household cooking in Indian scenario subjected for various factors like socio-cultural patterns, purchasing pattern of certain foods (GLV, fruits, vegetables etc.) and individual preferences considered at households.

Frequency of processed food consumption:

The foods selected for the assessment were, most popular and accessible processed foods irrespective of gradient (rural-urban). The findings revealed that, consumption of convenient energy dense foods, was more in rural than urban. Rapid urbanization has been shown to be positively linked to increased adaptation to western foods in many developing societies. There is a general belief that acceptance of processed foods in urban population is much easier and accounts for a higher proportion of food expenditure, but purchase and consumption of this particular foods also increasing even in rural sector. Primary driving force for purchase of processed foods was media influence. Price and quality of foods were influencing factors for purchase whereas saving of time was major reason for selection of such

foods (Praksh, 2015).

Body mass index (BMI):

The findings of BMI assessment revealed that, number of normal individuals was in decreasing trend from rural to urban area. Indicating malnutrition in increasing trend towards urban. Overall, incidences of overweight and obesity were more compared to underweight. Interactions between genetic predisposition, dietary and lifestyle factors are believed to account these recent changes. An excess amount of body weight has been associated with increased risk of cardiovascular disease, diabetes, certain types of cancer, mortality and the obesity associated co-morbidities are of major public health concerns (Hongyu *et al.*, 2013). A community-based study on prevalence of obesity among urban population of Shivamogga, Karnataka, conducted by Nagendra *et al.* (2017) reported that, the prevalence of high BMI among study subjects was close to 50 per cent (45.6%). Obese and overweight individuals were more in urban compared to other gradients, reasons may be attributed to food transitions and sedentary lifestyle. The gradual decreasing trend in overweight and obesity was evident from urban to rural areas, which are regions with three different stages of urbanization (urban to transition followed by rural).

Table 3 : Factors affecting BMI in the rural-urban interface of Bangalore

Variables	Co-efficients
Age	-0.03
MUAC	0.622***
WHR	0.218***
Cereals intake	0.001**
(D1)	0.624***
(D2)	0.315
(D3)	0.386**
(D4)	1.093***
Intercept	3.092***
R ² value	0.570
F value	125.33***

Note :

D1: Rural =0, Transition=0 Urban =1

D2: Rural=0, Urban=0, Transition= 1

D3: North= 0 South =1 D4: Men=0 Women = 1

*, ** and *** indicate significance of values at P=0.1, 0.05 and 0.01, respectively

Factors affecting BMI:

Present findings revealed significant impact of

urban on BMI of household members. Urban living is influenced by lifestyle modifications leading to the consumption of high calorie foods and low physical activity, responsible for weight gain and increase in BMI. Peru Migrant study reported that, in comparison with rural habitants, urban individuals and rural-to-urban migrants have a higher incidence of obesity. Obesogenic environments might explain why people living in urban areas, whether urban dwellers or rural-to-urban migrants, show a high risk of obesity relative to rural subjects. Studies suggests that migrant and urban individuals are more physically inactive and sedentary relative to rural participants (Carrillo-Larco *et al.*, 2015). Among the two transects studied extent of urbanization was more skewed towards south transect, leading to comparatively less agricultural activities, adoption of newer occupations with decreased physical activities and dietary changes causing positive impact on BMI. Women are more prone to weight gain due to, having more fat mass in body composition and physiological changes during stages of life. Sattar *et al.* (2013) studied factors affecting BMI and reported that, females are always on the higher side of BMI. Further, increase in Mid Upper Arm Circumference (MUAC) results, not only from increase in muscle mass but also from accumulation of fat in subcutaneous layer of skin, leading to increase in body weight. Waist Hip Ratio (WHR) is the indicators of deposition of fat around vital organs of the body. When this fatty deposition increases also leads to increase in overall body weight. Cereals are main sources of carbohydrates in our daily diet. Excess consumption of cereals may lead to the conversion of carbohydrates to fats in the body tissues to store as energy reservoir in the adipose cells. Barooah and Barooah (2018) reported that, statistical correlations between the prevalence of overweight and obesity in terms of BMI with food habit in terms of cereals revealed a positive association.

Conclusion:

Food consumption findings revealed more than adequate consumption of refined cereals, oils, fats and sugars among the investigated households. Adoption for consumption of processed foods existed in urban and in rural areas. Additionally, least diversified foods consumption indicate inadequate nutrient intake especially micronutrients, as the diets were lacking in fruits, vegetables, milk and milk products. These food

consumption patterns in the rural-urban interface of Bangalore, reveals the susceptibility of household members for weight gain and depicted incidence of overweight and obesity, especially in urban and transition areas. Since, these are the root causes for non-communicable diseases, there is a need for awareness, intervention and promotion of diversified, functional and protective foods. Collectively, growing urbanization in Bangalore mega city is influencing on surrounding localities with respect to food consumption pattern and increasing body mass index. Hence, it is essential to address these aspects to protect health and nutritional status of individuals.

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