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Ekta Sawai

Department of Agricultural Economics and Statistics, Dr. PDKV, Akola, Maharashtra, India

NV Shende

Department of Agricultural Economics and Statistics, Dr. PDKV, Akola, Maharashtra, India

VK Khobarkar

Department of Agricultural Economics and Statistics, Dr. PDKV, Akola, Maharashtra, India

PK Wakle

Bhauasheb Fundkar Govt. College of Agriculture, Buldhana, Maharashtra, India

RD Walke

College of Agriculture, Akola (MH), India

Corresponding Author:

Ekta Sawai

Department of Agricultural Economics and Statistics, Dr. PDKV, Akola, Maharashtra, India

Estimation of adult equivalent scale for consumption expenditure of food and non-food items in rural and urban households in Amravati district

Ekta Sawai¹, NV Shende², VK Khobarkar³, PK Wakle⁴, RD Walke⁵

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ABSTRACT

The present study estimated adult equivalent scales for different age-sex groups using household consumption expenditure data from Amravati District of Maharashtra. Regression analysis was used to examine food, non-food and total expenditure across winter, summer and monsoon seasons. The results showed that school-going children (4–13 years) recorded the highest adult equivalent scale for total expenditure in the overall sample, reaching 1.09 in winter and monsoon and 0.80 in summer. For total food expenditure, males aged 20–40 years had relatively higher scales of 0.81, 0.59 and 0.79 during winter, summer and monsoon, respectively. The fitted models showed strong explanatory power, with R^2 values of 83.47–90.31 per cent for food expenditure. For total expenditure, R^2 ranged from 63.09 to 75.41 per cent. These findings demonstrate that household consumption needs vary considerably with age, gender and season. The estimated adult equivalent scales provide a useful measure for understanding household expenditure patterns and welfare more accurately than household size alone.

Keywords: Adult equivalent scale, Consumption expenditure, Age-sex groups, Household welfare, Amravati District

1. Introduction

India's economic growth and rising household expenditure have brought significant changes in food consumption patterns. Food expenditure remains a major component of household budgets and is closely related to nutritional security and household welfare. However, food requirements differ among household members according to their age and sex, making simple per capita expenditure an inadequate measure of actual consumption needs. The Adult Equivalent Scale (AES) provides a more realistic approach by assigning relative consumption weights to different age-sex groups, using an adult as the reference unit. It therefore accounts for differences in household composition and economies of scale in consumption. Regression-based methods are commonly used to estimate these equivalent weights when individual-level expenditure data are not available. The present study estimates adult equivalent scales for food consumption among households in Amravati District of Maharashtra, considering different age-sex groups and seasonal variations. The study aims to provide a better understanding of household food expenditure and the relative consumption requirements of family members, thereby offering useful insights into household welfare and resource allocation.

2. Methodology

The study was conducted in Amravati District of Maharashtra to examine household food consumption requirements using the Adult Equivalent Scale (AES). The study covered households from rural and urban areas and considered seasonal variations in consumption during winter, summer and monsoon. Primary data were collected through a pre-tested schedule using personal interviews with the selected households. Information on household composition, food consumption and expenditure was collected for the respective seasons.

2.1 Methods to estimating adult equivalent scale

In view of non-availability of data on consumption expenditure of specific item by the individual members of the household, the researcher in the past have used the regression analysis technique for estimating the specific expenditure weights for the various age – sex groups. In this study the data were obtained on actual consumption expenditure of food and non-food items taken together for family as a whole. The standardization of consumer units was done by using without / zero intercept regression technique.

2.1.1 Regression equation

Multiple linear regression analysis technique was adopted for estimating the consumer equivalent adult scale for the three main groups as well as total expenditure. The following form of regression model without intercept was fitted.

$$X_j = b_1 n_{1j} + b_2 n_{2j} + b_3 n_{3j} + b_4 n_{4j} + b_5 n_{5j} + b_6 n_{6j} + u$$

And $C_{ij} = b_1 n_{1j} + b_2 n_{2j} + b_3 n_{3j} + b_4 n_{4j} + b_5 n_{5j} + b_6 n_{6j} + u$

Where,

X_j = Total monthly consumer expenditure in the j^{th} household.

C_{ij} = Expenditure of i^{th} item in the j^{th} household. (Food / Non-food)

n_{1j} = Number of pre-school children (upto 4 years) in j^{th} the household.

n_{2j} = Number of school going children (falling the age group of 4-13 years)

in the j^{th} household.

n_{3j} = Number of family members in the age group of 13-20 years.

n_{4j} = Number of male family members in the 20-40 years age group.

n_{5j} = Number of female family members in 20-40 years age group.

n_{6j} = Number of adult family members in the age group of above 40 years.

$b_1, \dots, b_6$ = regression coefficient of respective variables

u = random disturbance term having zero mean and constant variance (σu^2)

The parameters b_1, b_2, b_3, b_4, b_5 and b_6 were estimated by ordinary least square (OLS) technique for rural, urban and semi-urban households and for all the seasons separately making total six set of estimates for each of main commodity groups. Similarly b_1, b_2, b_3, b_4, b_5 and b_6 were estimated without intercept.

The standard consumer units were selected as adult of 40 years and above. Thus, adult equivalent consumer unit scales are.

Table 1. Developing adult equivalent scale and standard household size

A	Pre-school children (upto 4 years)	b_1 / b_6
B	School going children (4- 13 years)	b_2 / b_6
C	Adolescent (13-20 years)	b_3 / b_6
D	20-40 male	b_4 / b_6
E	20-40 female	b_5 / b_6
F	40 years and above	$b_6 / b_6 = 1$

The weighted household size was derived by using the consumer units so estimated as follows:

$$1) \quad \sum w_{ig} n_{gj} = \frac{b_1}{b_6} n_{1j} + \frac{b_2}{b_6} n_{2j} + \frac{b_3}{b_6} n_{3j} + \frac{b_4}{b_6} n_{4j} + \frac{b_5}{b_6} n_{5j} + n_6$$

$$2) \quad \sum w_{og} n_{gj} = \frac{b_1}{b_6} n_{1j} + \frac{b_2}{b_6} n_{2j} + \frac{b_3}{b_6} n_{3j} + \frac{b_4}{b_6} n_{4j} + \frac{b_5}{b_6} n_{5j} + n_6$$

Where,

W_{ig} = specific adult equivalent scale for i^{th} item commodity in the g^{th} age- sex group.

W_{og} = expenditure adult equivalent scale common to all the consumption under g^{th} age – sex group.

$w_{ig} n_{gj}$ and $w_{og} n_{gj}$ are the standard household size corresponding to i^{th} food item and total expenditure, respectively.

Then,

$$\frac{C_{ij}}{w_{ig} n_{gj}} \quad \text{and} \quad \frac{x_j}{w_{og} n_{gj}}$$

Will give per consumer unit (adult equivalent) consumption / expenditure on the i^{th} item and per consumer unit total expenditure respectively for the j^{th} household.

3. Conclusion

3.1 Computation of adult equivalent scale

In view of non-availability of the data on consumption expenditure of specific item by the individual member of the households, the researcher in the past have used the regression technique for estimating the specific expenditure weights for various age sex groups.

Table 2. Adult equivalent scale for different commodity expenditure groups in rural households during various seasons

Main commodity groups	Age sex groups for rural						Reg. coefficient associated with adults (Rs.)	R ² Per cent
	Pre-school child	School chil-	Adolescent	Male 20-	Female	Adults		
	(0-4 yrs)	dren (4-13 yrs)	(13-20 yrs)	40 yrs	20-40 yrs	(above 40 yrs)		
	(N1)	(N2)	(N3)	(N4)	(N5)	(N6)		
Winter								
TF	0.57	0.06	0.68	1.09	0.74	1.00	1816.22	94.90
TNF	0.07	-0.11	0.43	0.94	1.26	1.00	2136.51	91.41
TOT	-0.10	-0.02	0.31	0.93	0.83	1.00	4030.88	90.65
Summer								
TF	0.10	-0.48	0.27	1.22	0.74	1.00	1968.75	80.21
TNF	1.05	-0.47	0.06	0.79	1.11	1.00	1956.81	86.75
TOT	0.60	-0.39	0.19	0.75	1.08	1.00	3982.60	89.54
Monsoon								
TF	0.22	0.14	0.56	1.03	0.67	1.00	1826.24	95.23
TNF	0.08	-0.14	0.33	0.92	0.91	1.00	1936.51	88.47
TOT	-0.11	-0.02	0.33	0.95	0.89	1.00	3920.88	88.65

The estimates of adult equivalent scales for main commodity group for different seasons for rural households revealed that the females in age group of 20-40 years accounted for maximum expenditure share in total non-food (TNF) and total expenditure (TOT) in summer season while men in age group of 20-40 accounted for the maximum ex-

penditure on total food (TF) in all three seasons. This is justified on the ground that males of the rural families are involved in various types of physical work like farming, dairying, wage labourer, self-employed etc. the further result revealed that the total expenditure taken together, increased with the higher age group.

It is evident from the table that adjusted coefficient of multiple determination (R^2) for expenditure on total food (TF) during all three seasons varied between 80.21 and 95.23 per cent. On total non-food

items (TNF) varied between 86.75 and 88.47 per cent and total items (TOT) varied from 88.65 and 90.65 per cent, respectively in rural households.

Table 3. Adult equivalent scale for different commodity expenditure groups in semi-urban households during various seasons

Main commodity groups	Age sex groups for Semi-urban						Reg. coefficient associated with adults (Rs.)	R ² Per cent
	Pre-school child (0-4 yrs)	School children (4-13 yrs)	Adolescent (13-20 yrs)	Male 20-40 yrs	Female 20-40 yrs	Adults (above 40 yrs)		
	(N1)	(N2)	(N3)	(N4)	(N5)	(N6)		
	Winter							
TF	-0.12	0.92	0.57	1.01	0.64	1.00	2120.08	90.47
TNF	-0.57	0.89	0.35	1.05	0.84	1.00	2752.45	85.99
TOT	-0.98	1.15	0.54	1.25	1.01	1.00	6118.61	83.54
Summer								
TF	-0.06	0.56	0.42	1.12	0.74	1.00	1975.25	86.71
TNF	0.87	0.41	0.04	0.93	0.84	1.00	3147.45	82.13
TOT	-0.04	0.78	0.39	0.77	0.95	1.00	6327.11	75.41
Monsoon								
TF	-0.16	0.91	0.60	1.03	0.77	1.00	2130.58	89.16
TNF	-0.57	0.89	0.35	1.05	0.74	1.00	2352.46	83.99
TOT	-0.98	1.15	0.54	1.26	1.15	1.00	5818.63	81.54

It is observed that the 20-40 years male accounted for the largest proportionate share of expenditure in total food (TF), total non-food (TNF) in winter and monsoon season and for summer season largest proportionate expenditure for total food (TF) and total non-food (TNF). The school going children in age group of 4-13 years accounted for the highest proportionate share of expenditure for total expenditure (TOT) in winter and monsoon season. Females of age group 20-40 years shows the highest share in total expenditure (TOT) in the all three seasons. The uneven trend was observed in total ex-

penditure with respect to ages group. Indicating that the family members in the age group of 20-40 years shares the largest expenditure. It is evident from the table that adjusted coefficient of multiple determination (R^2) for expenditure on total food (TF) during all three seasons varied between 86.71 and 90.47 per cent. On total non-food items (TNF) varied between 82.13 and 85.99 per cent and total items (TOT) varied from 75.41 and 83.54 per cent, respectively in semi-urban households.

Table 4. Adult equivalent scale for different commodity expenditure groups in urban households during various seasons

Main com- modity groups	Age sex groups for Semi-urban						Reg. coefficient associated with adults (Rs.)	R ²
	Pre-school child (0-4 yrs)	School chil- dren (4-13 yrs)	Adolescent (13- 20 yrs)	Male 20-40 yrs	Female 20-40 yrs	Adults (above 40 yrs)		
	(N1)	(N2)	(N3)	(N4)	(N5)	(N6)		
	Winter							
TF	0.70	0.75	0.41	0.35	0.61	1.00	2421.56	90.61
TNF	0.69	1.31	0.57	0.28	0.90	1.00	2970.46	72.12
TOT	0.74	1.41	0.57	0.40	0.66	1.00	6371.49	78.81
Summer								
TF	0.59	0.62	0.31	0.24	0.78	1.00	2186.01	86.56
TNF	0.53	0.71	0.31	0.21	0.78	1.00	2689.6	82.57
TOT	0.66	1.07	0.52	0.31	0.64	1.00	5715.36	83.60
Monsoon								
TF	0.64	0.69	0.44	0.34	0.62	1.00	2405.07	90.19
TNF	0.69	1.31	0.57	0.28	0.91	1.00	2970.46	72.12
TOT	0.74	1.41	0.57	0.40	0.67	1.00	6371.49	78.80

In the case of urban households, it was found that school-going children in the age group of 4-13 years accounted for the highest proportionate share of expenditure on both total food (TF) and total non-food (TNF) items during the Winter and Monsoon seasons, with equivalence scales of 0.75-0.69 for TF and 1.31 for TNF in both seasons. For Summer, the same age group continued to maintain a prominent share, particularly in total expenditure (TOT), with a coefficient of 1.07, indicating sustained educational and related non-food expen-

ditures throughout the year. Females in the age group of 20-40 years consistently showed higher equivalence scales than males across all three seasons for both food and non-food categories. Their relative weights ranged between 0.61 and 0.78 for TF and TNF, compared to 0.24-0.40 for males in the same age group. This indicates that adult females contribute a higher share to household expenditure, possibly reflecting differences in household roles and spending patterns. For total expenditure (TOT), school-age children (4-13 years) again ac-

counted for the largest share during Winter and Monsoon (coefficients of 1.41), followed by females aged 20–40 years. Pre-school children (0–4 years) also carried notable expenditure weights (0.66–0.74 for TOT across seasons), indicating significant costs at early childhood stages, particularly in health and basic services. An uneven trend was observed in total expenditure with respect to age groups, indicating that family members in the 4–13 year and 20–40-year categories together account for the largest shares of household spending in urban

areas. This reflects the dual burden of education-related costs for children and non-food service expenditure for working-age adults in urban settings. It is evident from the table that adjusted coefficient of multiple determination (R^2) for expenditure on total food (TF) during all three seasons varied between 86.96 and 90.61 per cent. On total non-food items (TNF) varied between 72.12 and 82.57 per cent and total items (TOT) varied from 78.80 and 83.60 per cent, respectively in semi-urban households.

Table 5. Adult equivalent scale for different commodity expenditure groups in overall households during various seasons

Main commodity groups	Age sex groups for Semi-urban						Reg. coefficient associated with adults (Rs.)	R ²
	Pre-school child	School children	Adolescent	Male 20-	Female	Adults		
	(0-4 yrs)	(4-13 yrs)	(13-20 yrs)	40 yrs	20-40 yrs	(above 40 yrs)		
	(N1)	(N2)	(N3)	(N4)	(N5)	(N6)		
Winter								
TF	0.23	0.69	0.52	0.81	0.54	1.00	2127.88	90.31
TNF	-0.18	0.90	0.40	0.92	0.52	1.00	2557.60	72.79
TOT	-0.35	1.09	0.51	0.99	0.36	1.00	5483.04	75.41
Summer								
TF	0.12	0.36	0.33	0.59	0.73	1.00	2036.74	83.47
TNF	0.77	0.53	0.19	0.49	0.72	1.00	2560.28	34.74
TOT	0.23	0.80	0.45	0.69	0.54	1.00	5274.51	63.09
Monsoon								
TF	0.18	0.66	0.53	0.79	0.49	1.00	2123.12	89.49
TNF	-0.19	0.90	0.39	0.92	0.52	1.00	2557.6	72.80
TOT	-0.36	1.09	0.51	0.98	0.35	1.00	5483.04	75.41

It is evident from the table 5.11 that school-going children in the age group of 4–13 years accounted for the highest proportionate share of expenditure for total expenditure (TOT) during the Winter and Monsoon seasons, with equivalence scales of 1.09 in both periods. This indicates that school-age children are associated with household spending that is equal to or even exceeds that of an adult, mainly due to education-related and service expenditures. During the Summer season, their relative weight remained high (0.80), though slightly lower than Winter and Monsoon, reflecting seasonal moderation of school-related costs. For total food expenditure (TF), male members aged 20–40 years exhibited relatively high equivalence scales during all three seasons (0.81 in Winter, 0.59 in Summer, and 0.79 in Monsoon), followed closely by adolescents and school-age children. This indicates that working-age males continue to be associated with a substantial share of household food expenditure across seasons. Female members aged 20–40 years also show moderately high TF weights, particularly in Summer (0.73), suggesting their significant role in household food consumption patterns. For non-food expenditure (TNF), school-age children (4–13 years) and male members (20–40 years) carry the largest relative weights during Winter and Monsoon (around 0.90–0.92), underlining the importance of educational, service, and transport expenditures in household non-food budgets. Pre-school children (0–4 years) show negligible or even slightly negative coefficients in Winter and Monsoon, indicating very low additional non-food costs for this group during these seasons. However, their weight rises sharply to 0.77 during Summer for TNF, likely due to seasonal spending on clothing, utilities, and health. For total expenditure (TOT), school-age children (4–13 years) consistently exhibit the highest equivalence scales (1.09 in Winter and Monsoon; 0.80 in Summer), followed by male adults (20–40 years) and then females. Adolescents show moderate expenditure shares (0.45–0.51), while pre-school children have low or negligible weights except for Summer (0.23). The adjusted coefficient of multiple determination (R^2) values further supports the robustness of these estimates. For total food expenditure (TF), R^2 values ranged between 83.47 and 90.31 per cent across seasons. For total non-food expenditure (TNF), R^2 val-

ues ranged between 34.74 and 72.80 per cent. For total expenditure (TOT), R^2 values varied between 63.09 and 75.41 per cent. These results confirm that household demographic composition plays a significant role in explaining variations in expenditure patterns, especially for food items.

4. Conclusion

The study concludes that household consumption expenditure in Amravati District varies considerably according to age, gender, household type and season. The estimated adult equivalent scales clearly show that household size alone does not adequately represent the actual consumption requirements of family members. In the overall sample, school-going children aged 4–13 years recorded the highest scale for total expenditure, at 1.09 in winter and monsoon and 0.80 in summer, mainly reflecting education and related expenses. For food expenditure, males aged 20–40 years showed relatively higher scales of 0.81, 0.59 and 0.79 during winter, summer and monsoon, respectively. The regression models provided good explanatory power, with R^2 ranging from 83.47 to 90.31 per cent for food expenditure. Overall, the findings highlight the importance of considering the demographic composition and seasonal requirements of households while assessing consumption and welfare. Adult equivalent scales therefore provide a more realistic basis for comparing household expenditure and designing policies related to household welfare and resource allocation.

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