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Determinants of Dietary Diversity Score for the Rural Households of Uttar Pradesh State

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Abstract

Good nutrition is a prerequisite for a healthy and active life, especially for an agriculture-dependent rural population. Inadequate food and nutrition affect human well-being, particularly for populations living in rural areas.However, diets in most rural households lack diversity because the intake of fruits, meat, poultry, fish, and green vegetables was low. This study estimates the factors influencing dietary diversity of the household and individual levels. The 248 sample households for surveys were determined by a stratified random sampling method. Household Dietary Diversity Score and individual dietary diversity score was assessed through the standard questionnaire developed by the food and agriculture organization of the United State, with 12 food groups and 9 food groups, respectivel pearson correlation coefficient was used to determine the relationship between the household diet diversity score or individual dietary diversity score with different studied variables. The findings show that the most consumed foods within the household are cereals, tubers, oils and fats, spices, and condiments. Females have low dietary diversity score compared to males in the households.The majority of the households and individuals had low diet diversity scores and foods from animal sources were rarely included as diets, particularly in households with low dietary diversity scores. The studies have shown a strong positive correlation between the level of education, the awareness status of homemakers and the attitude about food and nutrition. The nutritional knowledge, awareness, attitude, and educational status of the head of HH were also positively correlated with household dietary diversity score but the relationship was weak.

Keyword: Dietary Diversity Score; Rural Households; Food diversity; Food security; Food availability.

Introduction

Uttar Pradesh (UP) is the most populous state in India and has some of the highest rates of malnutrition as well as micronutrients deficiency.[1] Nutrition is a basic human need and a prerequisite to a healthy life.[2] The World Health Organization (WHO) has suggested that at least 20, perhaps as many as 30, biologically distinct variants of foods should be consumed each week for a healthy diet.[3] The promotion of diverse diets is one of several approaches to improving micronutrients in the habitual diet.[4]

According to Food and Agriculture Organization (FAO), Dietary diversity (DD) is defined as the number of food groups consumed over a reference period.[4] It reflects the concept that increasing the variety of foods and food groups in the diet helps to ensure adequate intake of essential nutrients.[1] Sufficient income resources, agrobiodiversity, heterogeneity within the landscape, and livelihood diversity all supported their ability to consume a varied diet and achieve good nutritional status. Other variables affecting diet and DD included seasonality, Household (HH) size, and gender.[5,6] As DD promotion becomes an increasingly common component of nutrition education, understanding local nutrition knowledge systems and local

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concepts about DD are essential to formulate efficient messages.[5] As it has been revealed in many types of research, the social and economic condition of the HHs affects Household Dietary Diversity Score (HDDS).[6] Similarly, efforts have been made to find out the relationship with other factors in a better way in the rural area of Uttar Pradesh state. DD can be measured at the HH or individual level through the use of the questionnaire.[4,7] Most often it is measured by counting the number of food groups rather than the food items consumed. At the household level, DD is usually considered as a measure of HHs capacity to access costly food groups; while at the individual level it reflects dietary quality, mainly the micronutrient adequacy of the diet. Although the reference period can vary, it is most often the previous day or week.[8]

Methodology

This was a cross-sectional study, which was structured based on the WHO & FAO's dietary diversity questionnaire that was revealed in 2013.[9,10] Also, we used the FAO's third version of the guidelines for measuring HDDS and Individual Dietary Diversity Score (IDDS). To assess the influencing factors of HDDS and IDDS studies in the following manner: (I) Demographic and socio-economic factors (II) Food availability and accessibility(III) Utilization and distribution (IV) Nutritional knowledge and attitude.

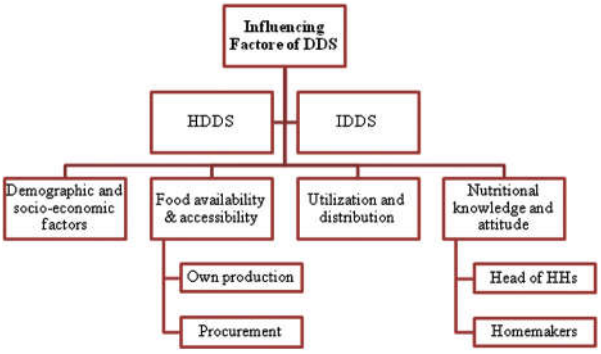

Fig. 1: Studied influencing factors of DDS.

Sample selection: A total of 264 HHs was randomly selected from Banda and Kannauj district of Uttar Pradesh state and 491 individuals from the selected HHs were selected to assess the IDDS and influencing factors.

Inclusion and exclusion: Only ≥13 to <60 years aged male and female individuals were included; pregnant and lactating women were excluded.

Study tools: In the present study's quantitative data was assessed, six standard tools were used after local adaptation. (I)Enumeration schedule, (II)HH schedule, (III) Procurement & utilization schedule, (IV)The nutritional knowledge and attitude assessment questionnaire, (V) HDDS questioner, and (VI) IDDS questioner were used. All these tools were standard tools, which were translated into regional language by proper method before using it.

Data Collection: All the tools were administered by the researcher, interviews techniques were used for the quantitative data collection, anddata was collected in March 2018.

Variables: HDDS and IDDS were dependent variables in this study; which depended on the independents' variables: level of education, family type, family size, family income, religion, caste, sex, occupation of the head of HH, food availability, and accessibility, source of food procurement, utilization and distribution of food produced, nutritional knowledge, awareness, and attitude.

Data Analysis: Microsoft Excel data pack was used for the data analysis, in which the given functions were used to find the average, percentage, Standard Deviation (SD), t-test, and Pearson correlation (r-value). The strength of the association, for absolute values of r, 0-0.19 is regarded as very weak, 0.2-0.39 as weak, 0.40-0.59 as moderate, 0.6-0.79 as strong, and 0.8-1 as very strong correlation.

Measurement of HDDS: 12 food groups used suggested by the FAO during the Food and Nutrition Technical Assistance (FANTA) project 9(A) Cereals & millets (B) White tubers and roots (C) Vegetables (D) Fruits (E) Meat (F) Eggs (G) Fish and other seafood (H) Legumes, nuts, and seeds (I) Milk and milk products (J) Oils and fats (K) Sweets (L) Spices, condiments, and beverages. It is the sum of consumed food groups consumed with the reference period in the HHs (last day). A to L food groups have been used to measure the HDDS, with the potential score range is 1-12.

HDDS = Sum of consumed food groups (A+B+C+D+E+F+G+H+I+J+K+L)

Measurement of IDDS: 9 food groups was suggested by FAO for the measuring of IDDS[10] (A) Starchy staple (B) Pulses, legumes, nuts, and seeds (C) Organ meat and fish (D) Roots and tubers (E) Dark green & leafy vegetables (F) Other vitamin-A rich food & vegetables (G) Eggs (H) Milk and milk products (I) Fat and oil-based items. It is the sum of consumed food groups consumed with the reference period (previous day). A to I food groups have been used to measure the IDDS, with the potential score range being 1-9.

IDDS = Sum of consumed food groups (A+B+C+D+E+F+G+H+I).

Ethical Issues: Permission was taken from the Ethics Committee constituted by the institute and written consent with participants was also taken after explaining the study proposal in detail.

Results and Discussion

(I) Demographic and socio-economic factors

Demographic and socio-economic status is a major determinant of healthy diets, according to available literature, the high socioeconomic status may be associated with overall better dietary patterns and diet quality.[9] Several types of research have shown that DD is a good proxy indicator of dietary quality among communities living in rural areas.[10] HHs in low and middle-income groups typically base their diets on rare other food groups than their staple foods, which results in less DD.[11]

Table 1: HDDS according to the type of family.

Type of family	n	Mean HDDS	SD
Nuclear	120	5.61	1.90
Extended nuclear	54	5.33	1.95
Joint	64	4.95	1.81
Collectively	256	5.30	1.94

HDDS of nuclear families was the highest (5.61), the extended nuclear and joint families had HDDS of 5.33 and 4.95, respectively (Table 1) in the present research. Type of family has an impact on dietary intake as a proximal food environment and family structures are changing and becoming more diverse.[12]

Table 2: HDDS according to family size.

Number of family members	n	Mean HDDS	SD	r-value
1 – 4	98	5.68	1.77	-0.33
5 – 7	144	5.20	1.87	-0.35
≥ 8	14	4.45	2.14	-0.48
Collectively	256	5.30	1.94	-0.47

A family with 1-4 members had HDDS 5.68 (highest), while the family with more than 8 members had a 4.45 (lowest) HDDS (Table 2). Pearson's correlation (r-value)-0.47 shows a negative weak negative correlation between family size and HDDS. According to a study, the number of grossing members in the family has a positive effect on the food group's intake.[14] Whereas the relation between the number of dependent members in the family and food groups in the HHs was found a negative effect. Current research has proved that small family size is responsible for good HDDS.

Table 3: HDDS according to different income groups.

Income groups	n	Mean HDDS	SD	r-value
High	--	--	--	--
Upper-middle	66	6.16	2.01	0.12
Lower-middle	112	5.26	1.84	0.38
Low	78	4.48	2.41	0.40
Collectively	256	5.30	1.94	0.42

HDDS was directly influenced by family income and it's positively correlated (Table 3) with r-value 0.42; the highest HDDS (6.46) was from the upper-middle-income group and the lowest(4.48) score was obtained by the low-income group. Evidence from many kinds of researches showsthat HDDS is strongly associated with HH per capita income[13,14]

Pearson's correlation r-value 0.42 was showing a weak positive correlation between family income and HDDS. An improvement in family income has also improved the buying capacity of food items, but weak the relationship between HDDS family income was indicating that other factors were alsoinfluencing the score.

The level of education of the head of the HH had influenced the HDDS with an r-valueof 0.34 was showing a positive but weak correlation (Table 4). The education level of homemakers was showing a strong positive correlation between HDDS with

Table 4: HDDS according to the education status of the head of HHs and homemakers.

Educational status	Head of HHs				Homemakers			
	n	Mean HDDS	SD	r-value	n	Mean HDDS	SD	r-value
Illiterate (0)	14	4.62	2.21	0	10	4.12	2.43	0
Read & write (1)	19	4.44	2.02	0	17	4.24	2.11	0
2 – 4 standards	88	5.21	2.34	0.11	94	5.02	2.42	0.14
5 – 8 standards	100	5.04	1.88	0.14	112	5.49	2	0.26
9 – 12 standards	23	5.73	1.54	0.18	25	5.92	1.45	0.31
College (13-15)	12	6.75	2.12	0.24	8	6.92	1.23	0.42
Collectively	256	5.30	1.93	0.34	266	5.30	2.05	0.71

an r-value of 0.71. In numerousresearches, the education level of homemakers and food intakes were associated.[17,18] Many recent studies have been conducted to evaluate the education level of homemakers with food frequency, use of food groups and food preferences are sowing education level of homemakers as an effective factor.[18,19] The effect of women on the food selection is more than the head of HH, while the head of the house is more concerned about the income of the HH, current research has proved the positive impact of women's education on HDDS.

Table 5: HDDS according to the major occupation of the head of HHs.

The major occupation of the head of HH	n	Mean IDDS	SD
Service	20	6.81	2.62
Business	12	6.31	2.71
Owner cultivator	98	5.30	1.9
Landlord + tenant cultivator	34	5.20	1.77
Others	4	5.15	1.68
Other labor	24	5.12	2.11
Artisans	12	4.32	1.88
Agricultural labor	52	4.18	1.97
Collectively	256	5.30	1.94

The data showing the impact of occupation of the head of HHs on HDDS, the score was highest among the head of HHs whose occupation was service and business, which was 6.81 and 6.31 respectively (Table 5). The head of HHs worked as agriculture labor had their HDDS lowest (4.18). The findings suggest that considering the unique characteristics of occupations and their related background factors with HDDS.[19] Food diversity in the population related to farming and its allied work in India was less than that of the population involved in the other occupations.[20] An occupation that is responsible for visiting the nearest city or town every day has to maintain a market link, which encourages shopping.

Table 6: HDDS and cast status.

Community	n	Mean HDDS	SD
Others (general)	62	5.61	1.74
SC	52	5.29	2.42
OBC	140	4.99	1.94
ST	0	--	--
Collectively	256	5.30	1.94

HDDS was found (Table 6) to be the highest (5.61) among the other (general) cast HHs, whereas the lowest score (4.99) had found in the Other Backward Cast (OBC). The exact score (5.29) of the ScheduledCast (SC) was better than the OBC. These results confirm that the casting status of studied HHs and HDDS are different in this area. Most of the people of SCs were going for the te paid work in the nearby town, due to which they had daily access to the market was resulting in better purchasing capacity compression to OBCs.[21]

Table 7: HDDS and religions.

Religion	n	Mean HDDS	SD
Hindu	226	5.21	1.91
Muslim	30	5.39	2.08
Christian	0	--	--
Others	0	--	--
Collectively	256	5.30	1.94

Only two types of religions were found in the study area, and the HDDS was found to be higher in Muslim HHs than Hindus, which were HDDS 5.18 and 5.48, respectively (Table 7). Indian diets are strongly impacted by religion and all of these groups have different food habits and different food restrictions that impact their cuisine.[22] For example, Hindus are mostly prohibited from eating beef; Muslims do not eat pork. A vast number of Hindus are vegetarians, fresh meat, poultry, eggs, and fish are often excluded from the diet. Religious beliefs hinder the full utilization of available food items.[23]

Table 8: IDDS according to sex and age groups.

Sex	Group	n	Mean IDDS	SD
Male (18-59 years)	Sedentary workers	17	4.56	1.77
	Moderate workers	90	4.46	1.83
	Heavy workers	26	4.40	1.64
Female (18-59 years)	Sedentary workers	77	4.22	1.87
	Moderate workers	98	4.36	1.88
	Heavy Workers	11	4.20	2.02
Boys	13-15 years	46	4.41	1.92
	16-17 years	26	4.27	1.89
girls	13-15 years	59	4.12	2.32
	16-17 years	41	4.03	1.81
	Collectively	491	4.31	1.72

The lowest IDDS 4.03 was of girls (16-17 years), and the highest IDDS 4.56 was of sedentary men (Table 8). The overall women's IDDS was 4.26 which was

more than the mean (4.31), while the men's IDDS was 4.43 which was higher than the mean score. The highest SD in girls 13 to 15 years aged was 2.32, which showed the most disparity in scores, the same SD in the group of men heavy worker with age 18 to 59 years old was 1.64, which was the lowest disparity in scores. In much important research, the nutritional intake of women was found to be worse than that of men in India.[1,26]

Table 9: IDDS and educational status.

Educational Status	n	Mean IDDS	SD	r value
Illiterate	24	4.64	2.00	–
Read & write	8	4.44	2.13	–
1 – 4 standards	176	4.23	2.01	0.54
5 – 8 standards	154	4.11	1.78	0.44
9 – 12 standards	87	4.23	1.88	0.57
Graduate/ diploma	42	4.96	2.03	0.53
Collectively	491	4.31	1.72	0.61

The staus of education among people increases the understanding and awareness of food[16], this impact is being displayed in this research with the moderate positive relationship between IDDS and the education status of individuals as r-value 0.61 (Table 9). The highest IDDS, 4.96 was in the group of graduate/diplomapassed respondents; the lowest IDDS was found at 4.11 in the 5-8 class passed respondents with the lowest SD 1.78 (Table 9).

(II) Food availability and accessibility

The literature suggests that Indian agriculture has a range of important influences on HDDS. The evidence on agriculture linkages to diverse diets is relatively weak.[15] While dairy animal ownership was found to be associated with improved dietary quality, larger HHs were in a better position to adopt dairy animals, which, in turn, might contribute to better HH nutrition.[17]

In the current research, the relationship of that food group's availability from its own production with the HDDS was found (Table 10). Green leafy vegetables, milk, and other green vegetables food groups production was showed a strong positive correlation with the HDDS, wherer-value were 0.88, 0.83, and 0.79 respectively.

There was no correlation of availability of fish, meat, and millets, from own production with HDDS, wherer-value were zero. Fruits, pulses, root & tubers, eggs and sugar, and honey showed a weak positive correlation with the HDDS, where r-value were 0.47, 0.26 and 0.24, 0.21, and 0.12 (very weak correlation) respectively.

Table 10: Agriculture production as different food groups and HDDS.

Food Groups	Per HHs availability in g/day	r-value
Cereals	970.26	0.06
Millets	33.67	–
Pulses	81.18	0.26
Fishes	12.34	–
Roots and tubers	394.3	0.24
Green Veg.	11.46	0.79
Green leafy veg.	16.72	0.88
Eggs	6.25	0.21
Milk & milk products	649.46	0.83
Fruits	124.48	0.45
Oil and fat	21.28	0.03
Meat & Poultry	37.78	–
Sugar & Honey	27.89	0.12
Condiments & spices	14.31	–

A systematic review was undertaken to identify the impact of vegetable production and consumption status. Out of 140 studies, 116 (83%) studies reported to increase intake of vegetables after that improvement in the production of vegetables after intervention.[27]

Procurement of food and HDDS

Table 11: Mostly source used for food procurement.

Most Procurement Source	n	%	HDDS
From the own Cultivation/Kitchen Garden/Livestock/ common source	112	42.42	5.50
Purchased through PDS/ other government relief	43	16.29	4.60
Purchased from the local market/local shops	32	12.12	5.14
Purchased from the main market/weekly market	77	29.17	6.00
Collectively	264	100.00	5.30

The highest HDDS 6.00 was in HHs procuring the food items from the main market, while HHs have their own production like cultivation, kitchen, garden, livestock, andthe common source had a second highest HDDS 5.50. HHs that were mainly procured from a PDS or other government source had the lowest HDDS of 4.60. Production of all required foodstuff at own state (land, kitchen

garden, livestock) has a positive impact on the nutritional status of the HH.[22]

Utilization and distribution of own production

Proper utilization of the food produced becomes essential to maintain the diversity in diet.[5] Effective food utilization depends in large measure on knowledge within the HH of food storage and processing techniques and basic principles of nutrition.[23]

Table 12: HDDS and utilization of production.

Distribution	Percent of total production	r-value
Retained for human consumption	26.00	0.22
Sold	63.00	0.06
Use for animal feed	08.00	0.00
Share to other HHs	02.38	0.26
Spoilage during storage	00.62	0.00

In the current research, the Pearson correlation between the HDDS and the utilization of food produced has been assessed. Five types of distributions were studied for the utilization of food, out of which a weak positive relationship between three distributions.

HHs sharing food produced with other HHs was found to have the highest correlation with HDDS, where the r-value was 0.26 when the relationship between retained for human consumption were r-valuewas 0.22. HHs that sold more food produced had the same increase in HDDS, but the association was very weak, with anr-value of 0.06. No relationship was found between the amount of food produced used for animal feed and HDDS, similarly, no association was found between the spoiled amount of food produced and HDDS, where is the r-value for the booth was zero.

Nutritional knowledge, awareness, and attitude

Nutrition knowledge and a positive attitude are known to influence dietary practices.[24] There is a paucity of information on nutrition knowledge, awareness attitude, and HDDS of rural HHs.

The impact of knowledge, awareness attitude in the HDDS for homemakers was 0.66, 0.70, and 0.75 respectively while for same value for the head HH was 0.36, 0.40, and 0.55 respectively. There was a positive effect on the HDDS of women's awareness and attitude was showed, the HDDS were also higher where women had higher awareness and higher attitude about food and nutrition. It has been proved in many research that the awareness level of women is responsible for good nutrition.[25,5,23] The head of the HHs had an effect on the HDDS but was a weak positive correlation. Nutritional knowledge, awareness, and attitude had a significant relationship with HDDS, but attitude had more correlated out of knowledge and awareness.

Table 13: Nutritional knowledge, awareness, and attitude of homemaker.

Components	Homemaker		Head of HHs	
	Mean score of the scale	r-value	Mean score of the scale	r-value
Knowledge	4.73	0.66	5.33	0.36
Awareness	5.02	0.70	5.22	0.40
Attitude	4.44	0.75	4.24	0.55

Conclusion

The mean HDDS of the study population was 5.30 out of 12, while the mean IDDS was 4.31. Mainly grains, roots, and cooking oil was consumed by the HHs or individual levels. The majority of the HHs had low HDDS or IDDS and foods from animal sources were a rare component in the HHs diets, particularly in HHs with low DDS. The studies have shown a strong positive correlation between the level of education, the awareness status, and the attitude about food and nutrition of homemakers with r-values 0.71, 0.70, 0.75, respectively.

The nutritional knowledge, awareness, attitude, and educational status of the head of HH were positively correlated with DDS but the relationship was not strong. There was a weak negative correlation between family size and HDDS was recognized with an r-value -0.47. Religious beliefs increase in eating all types of food, as a result, the score of Muslims was higher than that of Hindus. In additionally gender, age, occupation of the head of HHs, type of family, caste, religion, food availability, procurement of food, utilization or distribution of produced food were also linked with the DDS.

References

1. Gonmei Z, Toteja GS. Micronutrient status of the Indian population. Indian J Med Res. 2018;148(5):511-521. doi: 10.4103/ijmr.IJMR_1768_18.
2. World Health Organization. Micronutrients. Available from: http://www.who.int/nutrition/topics/micronutrients/en/.

3. Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. Nutr Rev. 2012;70(1):3-21. doi:10.1111/j.1753-4887.2011.00456.x.
4. Nair MK, Augustine LF, Konapur A. Food-Based Interventions to Modify Diet Quality and Diversity to Address Multiple Micronutrient Deficiency. Front Public Health. 2016;3:277. Published 2016 Jan 5. doi:10.3389/fpubh.2015.00277.
5. Powell B, Bezner Kerr R, Young SL, Johns T. The determinants of dietary diversity and nutrition: ethno nutrition knowledge of local people in the East Usambara Mountains, Tanzania. J EthnobiolEthnomed. 2017;13(1):23. Published 2017 Apr 27. doi:10.1186/s13002-017-0150-2.
6. Cordero-Ahiman OV, Vanegas JL, Franco-Crespo C, Beltrán-Romero P, Quinde-Lituma ME. Factors That Determine the Dietary Diversity Score in Rural Households: The Case of the Paute River Basin of Azuay Province, Ecuador. Int J Environ Res Public Health. 2021;18(4):2059. Published 2021 Feb 20. doi:10.3390/ijerph18042059.
7. Kumar, I., Gautam, M., Srivastava, D., Yadav, R. (2019). Assess the Diet Diversity Score along with the availability of food variety for a rural household in the Banda and Kannauj districts of Uttar Pradesh. American International Journal of Research in Formal, Applied & Natural Sciences, 25 (1), pp. 14-18.
8. Kumar, I. (2017) Assessment of the effect of low-calorie intake on cycle rickshaw pullers in Agra cant railway station. International Journal of Applied Research, 4 (1), 135-136.
9. Food and Agriculture Organization (FAO) Guidelines for measuring household and individual dietary diversity. Rome, Italy: Food and Agriculture Organization of the United Nations; 2011.
10. Food Agriculture Organization (FAO) Nutrition and Consumer Protection Division with support from the EC/FAO Food Security Information for Action Programme and the Food and Nutrition Technical Assistance (FANTA) Project. Rome, Italy: Guidelines for measuring household and individual dietary diversity; 2007.
11. Vakili M, Abedi P, Sharifi M, Hosseini M. Dietary diversity and its related factors among adolescents: a survey in Ahvaz-Iran. Glob J Health Sci. 2013;5(2):181-186. Published 2013 Jan 13. doi:10.5539/gjhs.v5n2p181.
12. Swaminathan, M. S., & Bhavani, R. V. (2013). Food production & availability are essential prerequisites for sustainable food security. The Indian journal of medical research, 138 (3), 383–391.
13. Baek YJ, Paik HY, Shim JE. Association between family structure and food group intake in children. Nutr Res Pract. 2014;8(4):463-468. doi:10.4162/nrp.2014.8.4.463.
14. Kearney J. Food consumption trends and drivers. Philos Trans R Soc Lond B Biol Sci. 2010;365(1554):2793-2807. doi:10.1098/rstb.2010.0149.
15. Kadiyala S, Harris J, Headey D, Yosef S, Gillespie S. Agriculture and nutrition in India: mapping evidence to pathways. Ann N Y Acad Sci. 2014;1331:43-56. doi:10.1111/nyas.12477.
16. Zhang Q, Chen X, Liu Z, Varma DS, Wan R, Zhao S. Diet diversity and nutritional status among adults in southwest China. PLoS ONE. 2017;12(2):e0172406.
17. Pradyumna A, Winkler MS, Utzinger J, Farnham A. Association of Livestock Ownership and Household Dietary Quality: Results from a Cross-Sectional Survey from Rural India. Int J Environ Res Public Health. 2021;18(11):6060. Published 2021 Jun 4. doi:10.3390/ijerph18116060.
18. Bosha T, Lambert C, Riedel S, Melesse A, Biesalski HK. Dietary Diversity and Anthropometric Status of Mother-Child Pairs from Enset (False Banana) Staple Areas: A Panel Evidence from Southern Ethiopia. Int J Environ Res Public Health. 2019;16(12):2170. Published 2019 Jun 19. doi:10.3390/ijerph16122170.
19. Tanaka R, Tsuji M, Asakura K, et al. Variation in Men's Dietary Intake Between Occupations, Based on Data From the Japan Environment and Children's Study. Am J Men's Health. 2018;12(5):1621-1634. doi:10.1177/1557988318780847.
20. Kadiyala S, Harris J, Headey D, Yosef S, Gillespie S. Agriculture and nutrition in India: mapping evidence to pathways. Ann N Y Acad Sci. 2014;1331:43-56. doi:10.1111/nyas.12477.
21. Kearney J. Food consumption trends and drivers. Philos Trans R Soc Lond B Biol Sci. 2010;365(1554):2793-2807. doi:10.1098/rstb.2010.0149.
22. Dhar AR, Oita A, Matsubae K. The Effect of Religious Dietary Cultures on Food Nitrogen and Phosphorus Footprints: A Case Study of India. Nutrients. 2021;13(6):1926. Published 2021 Jun 3. doi:10.3390/nu13061926.
23. William mcleod Rivera (2003) Agricultural Extension, Rural Development and the Food Security Challenge. Food And Agriculture Organization Of The United Nations Rome. ISBN 92-5-105035-X. Retrieved from http://www.fao.org/3/y5061e/y5061e08.htm#topofpage.

24. Kigaru, D.M.D., Loechl, C., Moleah, T. et al. Nutrition knowledge, attitude and practices among urban primary school children in Nairobi City, Kenya: a KAP study. BMC Nutr 1, 44 (2015). https://doi.org/10.1186/s40795-015-0040-8.

25. Workicho A, Belachew T, Feyissa GT, et al. Household dietary diversity and Animal Source Food consumption in Ethiopia: evidence from the 2011 Welfare Monitoring Survey. BMC Public Health. 2016;16(1):1192. Published 2016 Nov 25. doi:10.1186/s12889-016-3861-8.

26. Crimmins EM, Shim H, Zhang YS, Kim JK. Differences between Men and Women in Mortality and the Health Dimensions of the Morbidity Process. Clin Chem. 2019;65(1):135-145. doi:10.1373/clinchem.2018.288332.

27. Appleton KM, Hemingway A, Saulais L, et al. Increasing vegetable intakes: rationale and systematic review of published interventions. Eur J Nutr. 2016;55(3):869-896. doi:10.1007/s00394-015-1130-8.