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Food Consumption and the Size of People: Some Indian Evidence

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1. The significance of the level and quality of food intake of a population as indices of its health and well being has been the subject of a lively debate in recent years. One major focus of the discussion is the question raised by Sukhatme (1978, 1981, 1982) about the possibility of defining objectively the quantum of calories protein and other nutrients necessary for people of specified age, sex and activity levels to maintain normal health. He argued that apart from the variation in food requirement between individuals falling within the same age-sex-activity category (which has been well recognised), there are self-regulatory mechanisms for adjusting energy expenditure to intake which enable a given individual to maintain a normal level of activity without any significant change in body weight or loss of health despite day-to-day and week-to-week variation in the level of food intake or to be more precise, calorie intake). Sukhatme has also cited some evidence to show that intra-individual differences are much more important than inter-individual variations. On this basis he questioned the use of average nutritional norms as the basis for judging the incidence of poverty and under-nourishment, and for deciding the policy intervention appropriate to alleviating these conditions. While the existence of intra-individual variation is now generally accepted, the factors responsible for them and, even more so, their implication for the use of average nutritional norms

for measuring poverty and under-nourishment continue to be matters of controversy. (See for example, Dandekar, 1981, Krishnaji, 1981, Gopalan 1983).

2. Sukhatme's argument and evidence concerning the tendency of individuals to adjust energy expenditure to intake is based on data for a small sample concerning a relatively short period.[1] Moreover, the data on calorie intake for different individuals cited in his paper shows that while the daily level of intake of a particular individual and the average daily intake of different individuals are highly variable, there is hardly any variation in mean intake of particular individuals across weeks during the period of observation (3 weeks each spread over a period of 10 week) (Sukhatme 1982: 2004-7; 2009). The data therefore do not tell us much about the effect of sustained differences in the level of intake between different people at a point of time (or of the same individual over time) on their nutritional status. This is of considerable interest in the Indian context because growth of agricultural output during the past 2 decades has been trailing behind the growth of population in several states[2] and there is evidence that per capita real incomes of rural wage labourers, who are among the poorest strata of Indian society, has fallen.[3]

The nature of the food intake-size Relation

3. The nutritional status of an individual has of course several facets including height and weight, activity levels, productivity, clinical signs of nutritional deficiency and morbidity. If all these indicators are systematically and closely associated, then the effect

of food intake on nutritional status can be inferred by studying the relation of the former to any one of these indicators. But this is not always the case: E.g., it has been suggested that small sized people can be as healthy as large-sized ones (in terms of commonly accepted tests of nutritional deficiency and morbidity)[4] and that the level of activity and productivity per unit of time are not necessarily a function of size.[5] However, lack of information generally precludes a comprehensive assessment of nutrition status in terms all the relevant indicators. Since there is much more information on size of people (height and weight) than on health status or activity levels, we are better placed to investigate the relation between food-intake and size.

4. The expectation is that, for a given age-sex category, higher levels of intake will be associated with larger size both in terms of height and weight. This does not imply that differences in food intake between individuals are reflected exclusively in their height, weight and other measures of size. Part of the adjustment may take place through changes in activity level and/or intensity. It is also recognised that size differences may be the result of factors other than food intake (e.g., genetic differences, and variation in the health environment). But the latter two effects are not our concern here: If these influences are dominant, and are not related to the level of intake, then we would find that there is no strong relation between food intake and size. For the purposes of the present study "food intake" will be measured by per capita calorie consumption and height and weight will be used as the indices of size. Since size is a function of age and sex, the focus will be on differences in mean height and weight between people of the

same age-sex categories.

5. Ideally analysis of the food intake size relation requires data on food consumed individually by people of each age-sex category. However such information, as is well known, is very difficult to get. Typically the basic unit for food consumption/nutrition surveys is the household which consists of persons of different age, sex and activity status. It is not possible to infer from the household level information the consumption of individual members.[6] Under these circumstances, the only course open is to relate the size of particular age-sex categories to the average per capita consumption of their families classes or regions as the case may be. This necessarily involves some hypothesis (or assumption) on intra-family distribution of food.

6. The simplest assumption would be that the intake of individual members of different households varies in the same proportion as their respective mean intakes per capita. This does not imply equal distribution within the family, though variation in the age sex-activity composition of families makes it difficult to give it precise meaning. More important, it is widely believed that there is systematic discrimination in intra-family distribution particularly against females.[7] Such discrimination is generally ascribed to culturally ingrained prejudices, though one also can think of other reasons: For instance it seems only reasonable that when there is inadequate food in a family, the needs of working members (usually males), on whose earnings the others depend, will have the first claim on the supply leaving the remainder to be shared among the rest. Whatever the reason, it seems

but plausible that such discrimination has something to do with the overall supply of food to the family: the more abundant the supply relative to the requirement of healthy living, the less is likely to be the intra family inequality.

7. To the extent that the consumption of individuals is proportional to the mean per capita intake of their families, one would expect the mean size (height and weight) of individuals of each age-sex category to be positively correlated with the mean per capita intake of the family. But in so far as, intra-family distribution is itself systematically related to its mean per capita intake, the above relation should be more pronounced in some category of members and less in others. We will concentrate on the discrimination between the sexes which is generally believed to be the most widespread. And since, for reasons cited, the prospect of such discrimination would seem to be greater in a situation of low overall mean intake per head compared to a high level of intake, the expectation would be that the differences in height and weight of females relative to mean percapita intake would be greater than in the case of males which is equivalent to saying that the ratio of male to female height (and weight will fall as the mean per capita intake rises.

The available data

8. The National Institute of Nutrition (NIN) has conducted several detailed field surveys of food intake, nutritional status and anthropometric measurements in different parts of India over the last 2-3 decades. Some of these enquiries are of limited scope being confined to particular towns/villages or sections of the population. But the

Institute has also carried out two large-scale sample surveys which give anthropometric data for a number of states at two points of time. This body of data offers much scope for studying the size-intake relat and changes in size over a period of time.

9. The first of these surveys, covering 11 states, was done betwee 1956 and 1965. Its scope was limited to collecting data (based on act measurement by trained investigators) relating to height, weight and a few other anthropometric indices for children aged 1 to 21 years. Whil the survey did not collect any data on food intake it did classify the children by socio-economic background (in terms of religion, caste and broadly defined per capita income class) of their families. A detailed report of its findings giving the mean values and standard deviations o anthropometric measurements by sex and age for each state and tabulatio to bring out the differences in height, weight etc. of children from different socio-economic classes for the pooled sample have been publis (ICMR, NIN 1972).

10. Unlike in the earlier survey, those conducted by the National Nutrition Monitoring Bureau (NNMB) pertains to a sample of household in rural and urban areas of different states selected on the basis of a well defined procedure. It ascertains by weighment and, for a small fraction of the sample, by oral enquiry, the actual food intake of the family for one day; anthropometric measurements (including height and weight) are taken for all members of the household who are also screened clinically for signs of nutritional deficiency according to a certain number of explicitly stated indicators. For 8 states these surveys have

been done every year since 1974, two more have been added to the list in 1977 and 1978. Published reports giving summary results of the surveys by States are available upto 1979 (ICMR, NIN, 1980) our analysis is necessarily limited to these published tabulations which give only mean value of heights, weight and intake for the rural sample by states. The number of sample households in each year being too small to permit analysis of individual age categories, we have used the pooled estimates for 5 years (1974-79).

11. A major difficulty in using the NIN data is the inadequacy of information on food intake. The first round of surveys (1956-65) did not collect any data on this aspect. The more recent surveys collected intake data for each household (and for a portion of the sample by individuals) but only for a single day. If the daily food intake of each family were reasonably stable, this would give a pretty good idea of the normal average intake over the year. But in fact there are very wide variations in the food intake of families, and of individuals, from day to day and season to season. Therefore intakes of a given family on a particular day may not be reliable as a measure of mean intake over a season/year. And since different households are surveyed at different times, the survey data may not give a reliable measure of differences in mean intake over a season/year between households and between states. The relative rankings of the states in terms of per capita caloric intake is rather unstable from year to year, and does not correspond closely to the rankings based on the National Sample Survey. Since the published tabulations permit only comparisons of state averages, we need some way of ranking states according to sustained mean intake over a fairly long period.

12. The National Sample Survey gives estimates of caloric intake per capita for rural and urban areas, by state, for 1961-62 and the early 1970s. Since the NSS collects data on consumption for a 30 day period from each household and the survey is so arranged as to capture seasonal variation, its estimate give a better idea of the mean annual intake at the state level than the NNMB. There are ofcourse several questions about the accuracy of NSS data on food consumption and in particular on the nature and extent of non sampling errors therein (Vaidyanathan 1983). Nevertheless, on the assumption that the magnitude and direction of errors (especially non-sampling) are not systematically related to the level of consumption — and this does not seem unreasonable - we could use the NSS to define the relative position of the states in respect of sustained mean food intake.

13. Even this procedure raises two difficulties in the case of the first NIN survey: Since it was conducted at different times in different states spread over a 10 year period there is the problem of deciding which round of the NSS is to be used for ranking. In any case such ranking is possible from published data only for one year, namely 1961-62. There is also the problem that the NIN tabulation relates to a sample which includes both rural and urban areas, the coverage of the latter being disproportionately large. These difficulties do not arise in the NNMB surveys. We have taken the simple average of per capita caloric intake in rural areas of each state for 3 years (1971-72, 1972-73 and 1973-74) on the basis for ranking.[8/] Given the errors in the data, the high level of aggregation at which the relation has to be studied and the fact that the rankings of states by mean intake and by size of people are

derived from different sources relating to two different point in time, the results of our efforts to explore the size - intake relations must necessarily be very tentative. Nevertheless they are sufficiently suggestive to merit reporting.

Mean Intake and Mean Size: Some Cross Section evidence

14. The published tabulations of the first NIN survey do not permit a study of intake-size relation across states. However it does give a tabulation of the pooled data of mean height and weight by age and sex classified by range of per capita income which is a good proxy for ranking groups according to mean level of food intake per caput.

Table 1: Mean Height and Weight of male and female children of families with different levels of percapita Income, India 1956-65

PCY* Class	Height (Cms.)				Weight (kg)			
	Males		Females		Males		Females	
	4 year	19 year	4 year	19 year	4 year	19 year	4 year	19 year
I	93.6	162.7	93.1	149	12.9	46.9	12.4	39.6
II	94.7	162.9	93.2	150.5	13	47	12.4	42.2
III	94.8	163.2	93.4	151.7	13.2	47.4	12.4	40.4
IV	95.8	163.6	95.0	151.7	13.3	48.1	13.0	41.2
V	98.1	164.9	95.9	152.9	13.9	49.4	13.1	43.2
VI	98.4	165.8	97.7	152.9	14.1	49.5	13.9	43.3
VII	100.5	165.6	98.9	153.5	14.8	51.4	14.2	44.5

*In ascending order.

Source: ICMR, NIN:1972

These data (See Table 1) show that (a) mean height and weight for both sexes increases with percapita income; (b) the difference in height is much more

pronounced at age 4 than of 19 (especially for males) which implies that the increment in height tends to be larger in the poor groups than in the rich; and (c) the increment in weight between 4 and 19 years is generally an increasing function of per capita income. The usefulness of these associations is however limited by the fact that they are derived from pooled data in which systematic differences in mean consumption, environment, and perhaps genetic characteristics across regions and between rural and urban areas are confounded with the effect of intake per se. A more disaggregated analysis by individuals states and occupational/caste groups, which should be possible by retabulation of the primary data, can mitigate some of these limitations.

15. For the more recent NNMB surveys, published tabulations permit comparisons of mean size and mean intake across states but only for rural areas (Tabulations of both size and intake for urban areas and of size by income-activity categories are not yet available). The available information of mean height and weight by sex and selected age groups[9] (representing the average for 1974-79) for 10 states ranked according to per capita calorie intake during 1971-1973 are presented in Table 2 and 3. From a comparison of the extremes of the spectrum of food intake, it is seen that people of a given sex and age are invariably taller and heavier in states which rank highest in terms of food intake compared to those at the bottom. If higher intake always resulted in larger size, and size were not influenced by any factor other than intake, there should be very high correlation between intake and size.[10] However in fact, observed size is influenced by factors other than food intake and

Average Height by sex and selected age groups in Indian States* 1974-78

(Cms)

	Males of age					Females of age				
	4	19	[illegible]-24	45-44	55-59	4	9	[illegible]-24	40-44	55-59
1. Kerala	93.5	160.	169.1	161.8	160	92.6	149.5	150.1	149.3	146.7
2. West Bengal	94.1	160.3	161.7	161.4	160.5	92.7	149.4	149.4	148	146.5
3. Maharashtra	97.1	162.6	163	162.7	162.6	93.4	150.1	151.1	149.7	148.2
4. Tamil Nadu	94.3	161.6	162.2	163.1	162.1	90.8	151.5	151.2	149.8	149.4
5. Orissa	93.3	161.9	161.1	161.1	160 2	92.5	148.9	149.4	149.4	147.2
6. Gujrat	95.3	162.4	163.7	163.2	162.9	92.4	151.5	151.9	150.4	149.6
7. Madhya Pradesh	93.1	161.6	162.6	164.4	162.5	93	150.5	151.1	150.4	151.2
8. Karnataka	95.7	163.1	164.1	164.3	162.7	93	152.8	151.5	150.8	149.4
9. Uttar Pradesh	95.5	162.3	163.5	163.4	161.6	93.6	149.9	149.2	148.3	147.3
10. Andhra Pradesh	97.7	161.9	163.5	163	163.3	90.7	151.3	151	150.6	150

Source: ICMR, NNB, 1980

*Ranked in ascending order of average per caput calorie Intake 1971-73.

Average Weight by sex and selected age groups in Indian States* 1975-1978

(kg)

	Males of age					Females of age				
	4	19	20-24	40-44	55-59	4	19	20-24	40-44	55-59
1. Kerala	12.6	44	48.1	48.8	47.6	12.2	43.2	42.7	41.2	40.2
2. West Bengal	12.3	44.7	47.2	46.4	46.4	11.8	40.2	41	39.1	36.4
3. Maharashtra	11.9	46.5	47.7	50.3	50.9	11.7	42.9	41.9	41.4	41
4. Tamil Nadu	12.8	46.5	47.5	52.4	50.2	12	43	43.1	44.6	42.8
5. Orissa	12.4	47	48.5	49.2	48.6	11.9	42.1	43	42	3 .8
6. Gujarat	12.4	45.5	47.7	50.5	49.2	12.0	42.1	43.1	43.8	43.1
7. Andhra Pradesh	12.6	46.6	48.2	50.1	50.1	12.3	41.6	42.5	42.7	43
8. Karnataka	12.1	47.9	48.7	50.1	47.7	12.1	43.7	42.2	41.9	41.3
9. Uttar Pradesh	13.4	48.2	49.4	50.5	48.9	12.7	43.7	42.7	41.6	39.4
10. Madhya Pradesh	12.1	49.3	49.8	50.8	48.8	12.1	43.7	44.2	43.2	43.4

Source: GOI, NNB, 1980

*Ranked in ascending order of per caput caloric intake 1971-73

the data are always subject to error. Therefore the association between intake and size estimated from survey data is likely to be muted.

16. Table 4 gives the correlation coefficients between the ranks of the states by mean per capita caloric intake on the one hand and their ranks in respect of (a) mean height (b) mean weight and (c) mean weight per unit height for selected age-sex categories.[11/] Almost all the coefficients have a positive sign but not many are statistically significant. Interestingly the strength of the intake-size associations differs between age and sex categories, with the suggestion of a pattern. Thus, there seems to be little association between intake and height at age 4 for either sex; there seems to a stronger (though not statistically significant) positive association between the two at all other ages. Among females, unlike males, the strength of this association seems to rise with age. The weight-intake association in childhood and old-age is much stronger among females than males. But the reverse is the case at age 19 and in the group 20-24 years. The association is strongest among males of 19 year and 20-24 years of age (where the coefficients are also significant), but thereafter weakens rapidly. The latter tendency is not noticeable among females. In fact, the coefficients for weight per unit height bring out the contrasting patterns were sharply. From age 19, the correlation coefficients decline progressively with age in the case of males even as they tend to rise among females.

17. Further, as can be seen from Fig.1, the magnitude of weight differences as between regions with different levels of per capita caloric intake is generally greater among males than among females. Variation in mean intake seem to make a striking difference to 19 year old males and progressively less at higher ages; among females, weight differences associated with mean intake

Table 4: Association between Per Capita Calorie intake and Various Indices of Size

Age	Rank Correlation of Mean Calorie Intake per head and:							
	Mean Height		Mean Weight		Weight/Height		Ratio of Male to Fe	
	Male	Female	Male	Female	Male	Female	Height	Weight
4	-.033	.233	.090	.591	.115	.503	-.491	-.307
19	.618	.458	.900	.510	.903	.297	-.030	.552
20-24	.624	.091	.803	.400	.685	.467	.370	.273
40-44	.564	.624	.545	.527	.418	.515	-.2	-.224
55-59	.624	.651	.164	.503	-.006	.406	-.248	-.612

seems to get more pronounced with age. Fig.2, which relates to the extent of weight gain (loss) at different stages of life shows that the gain between 4 and 19 years is not only generally higher among males, but its magnitude also tends to be larger in better fed populations. Between 19 and 20-24 years males in relatively poorly fed regions gain more weight than in states with high average calorie intake; while in late middle age (40-44 to 55-59), when people generally seem to lose weight, the reduction tends to rise with mean per capita intake. Among female, no clear relation between weight gain (loss) and mean food intake of the population. These associations, it should be noted, relate the indices of size for particular age-sex category in each state with the mean intake for the entire population of that state. Differences observed between age-sex groups are most likely a reflection of differences in the way the available food is allocated between age-sex categories. This leads us to an examination of the relation between mean intake and distribution of food consumption by particular age sex groups.

Fig.1: FOOD INTAKE AND AVERAGE WEIGHT BY AGE & SEX

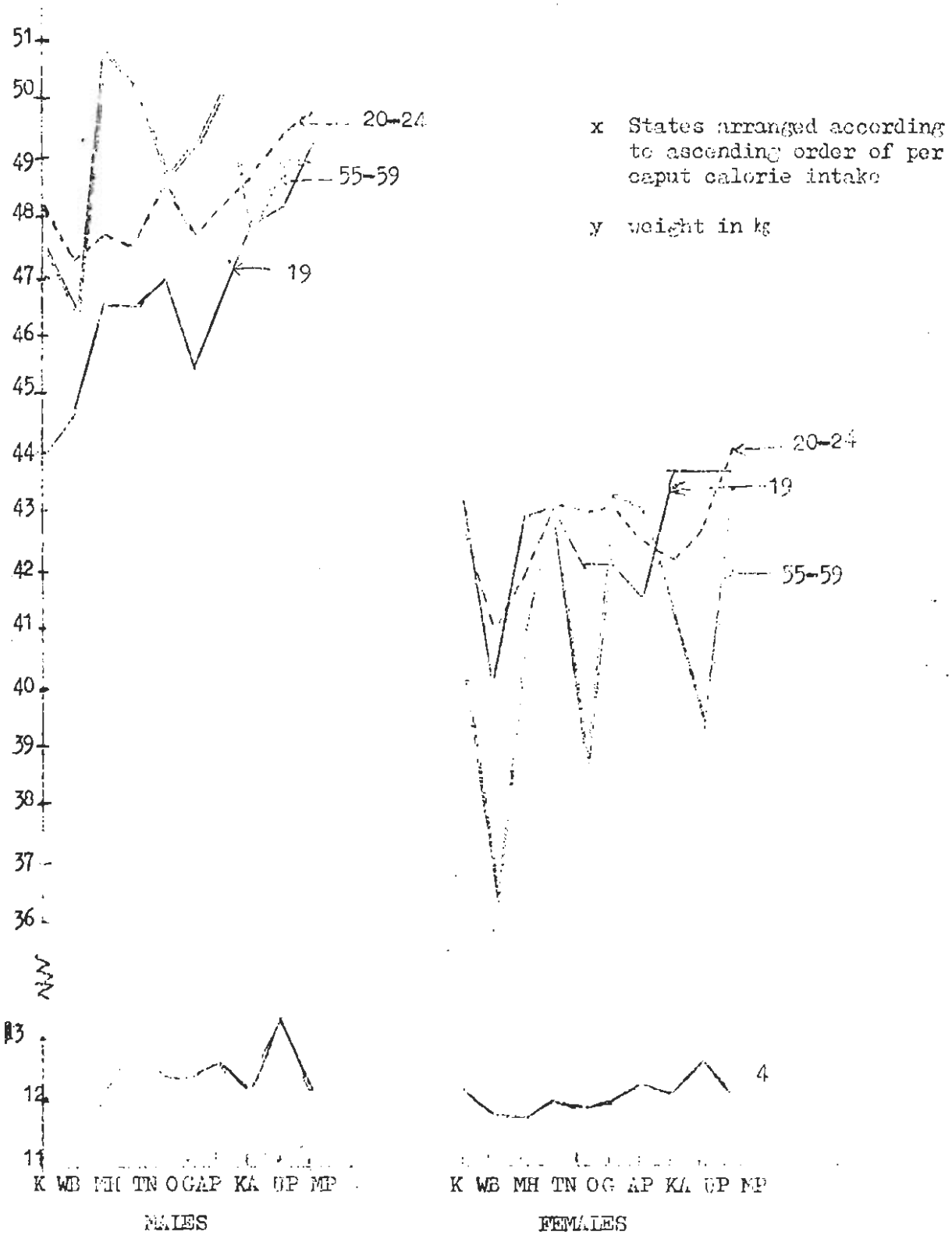
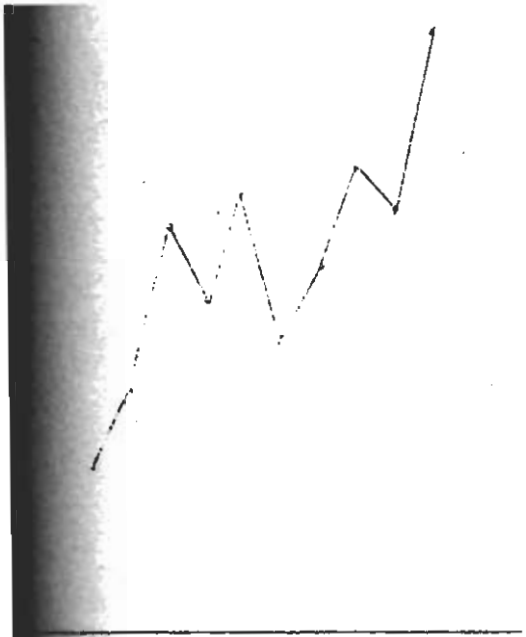


Fig.2

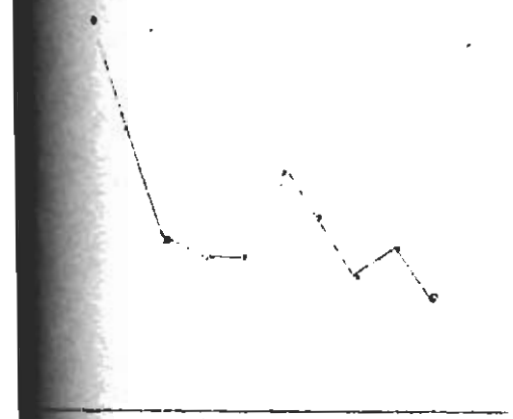
Weight Gain in kg between different ages by sex in states ranked by mean per capita calorie intake

X: States in ascending order of per capita intake

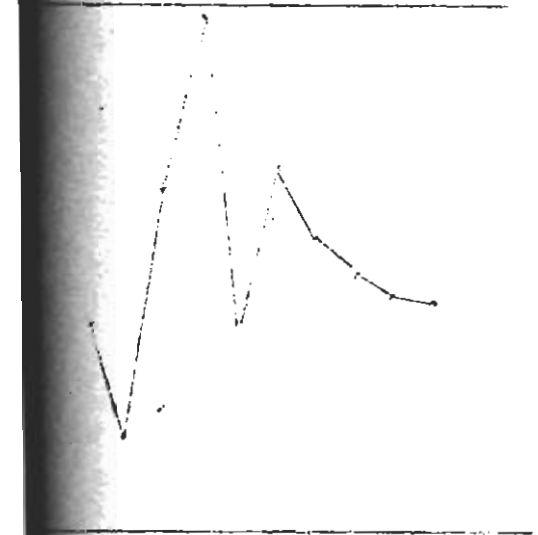
y: kg



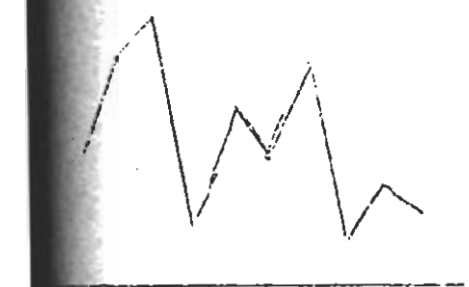
4 to 19 years



19 to 20-24 Yrs

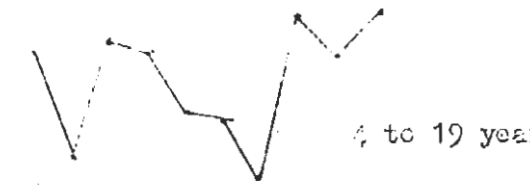


20-24 to 40-44 Yrs

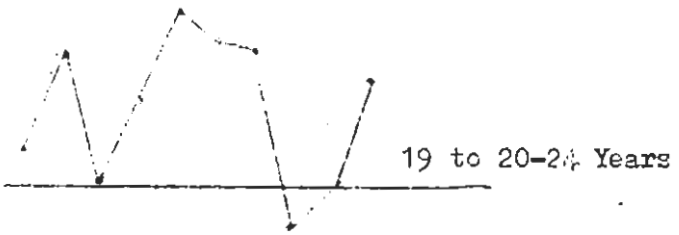


40-44 to 55-59 Yrs

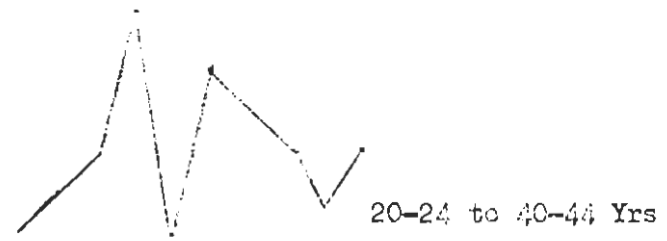
Males



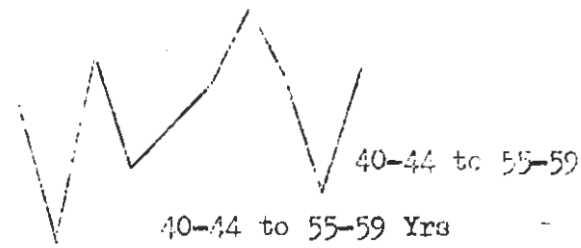
4 to 19 years



19 to 20-24 Years



20-24 to 40-44 Yrs



40-44 to 55-59 Yrs

K B MH TNO G APP KA UP MP

Females

Intra-family distribution of food: Sex discrimination?

18. We are concerned with two questions: First, is there a general discrimination of the basis of sex in the distribution of available food in India? And second, whether this discrimination tends to be more acute when the total supply available per head is relatively low. One way of testing the existence of discrimination would be to compare, as Sen (1983) has recently done, the actual height and weight of males and females of specified ages with the values expected of a well-fed, healthy population of the same genetic stock. Table 5 gives such a comparison of weight for children from 1 to 18 years, using the Harvard standard (HS) as the norm. Actual weight (and height) in all cases are below HS. Fig.3 presents the ratio of actual to HS norms in respect of weight per unit height for ages 1-18. If there were discrimination against females, the difference between actual and the corresponding HS values for them should be higher than for males. This seems to be the case only early childhood. During later childhood the data do not show any sustained or marked difference between the sexes in this respect; in fact during adolescence the deviation relative to HS is generally less amon, females. If the HS can be taken as a valid generalisation of the relative profiles of the growth curves of the human male and female, the data point to a general discrimination against females in early childhood but not in later. In the absence of any generalised height and weight standards for adults, it is not possible to say whether discrimination against females is a general phenomenon during later stages of life.

19. The data however provide some basis to examine whether the sex-discrimination in intra-family distribution of food is systematically related to the mean leave of food intake: If it is true that the food needs of males get first priority in intra-family allocation of food : one would expect

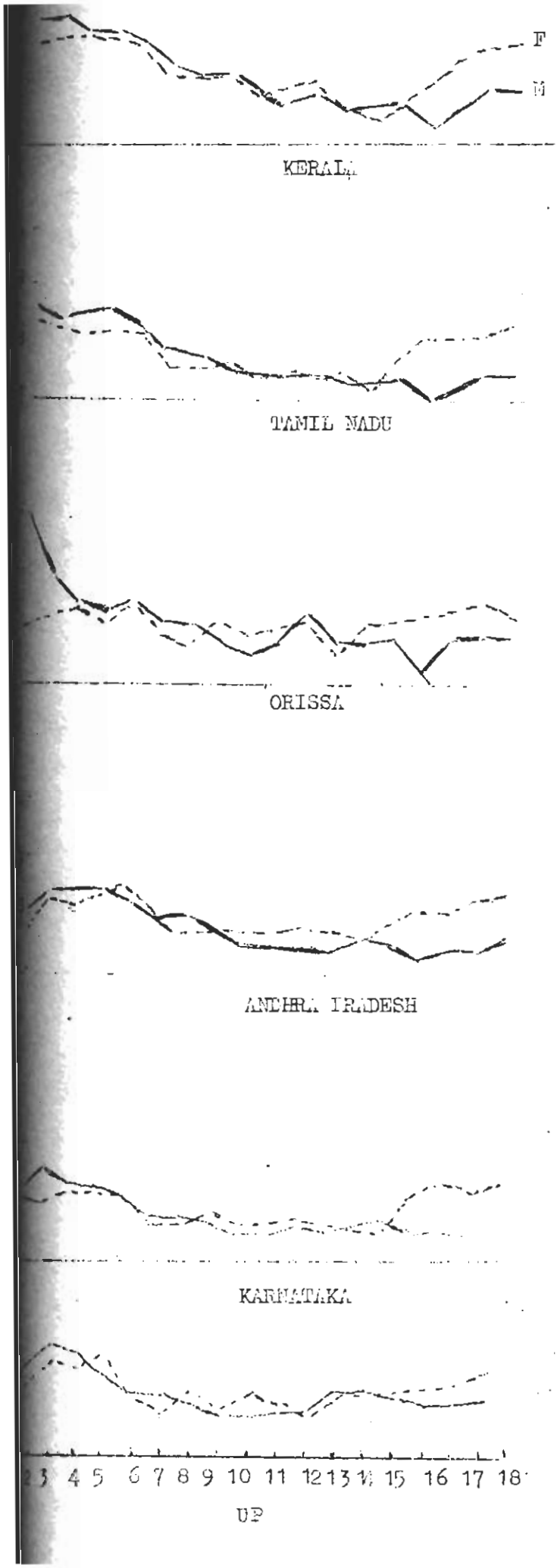


Fig.3: Weight for height Actual and according to Harvard Standard by age & Sex

x = age in years

y = $\frac{\text{Actual weight per unit hei}}{\text{HS Weight per unit height}}$

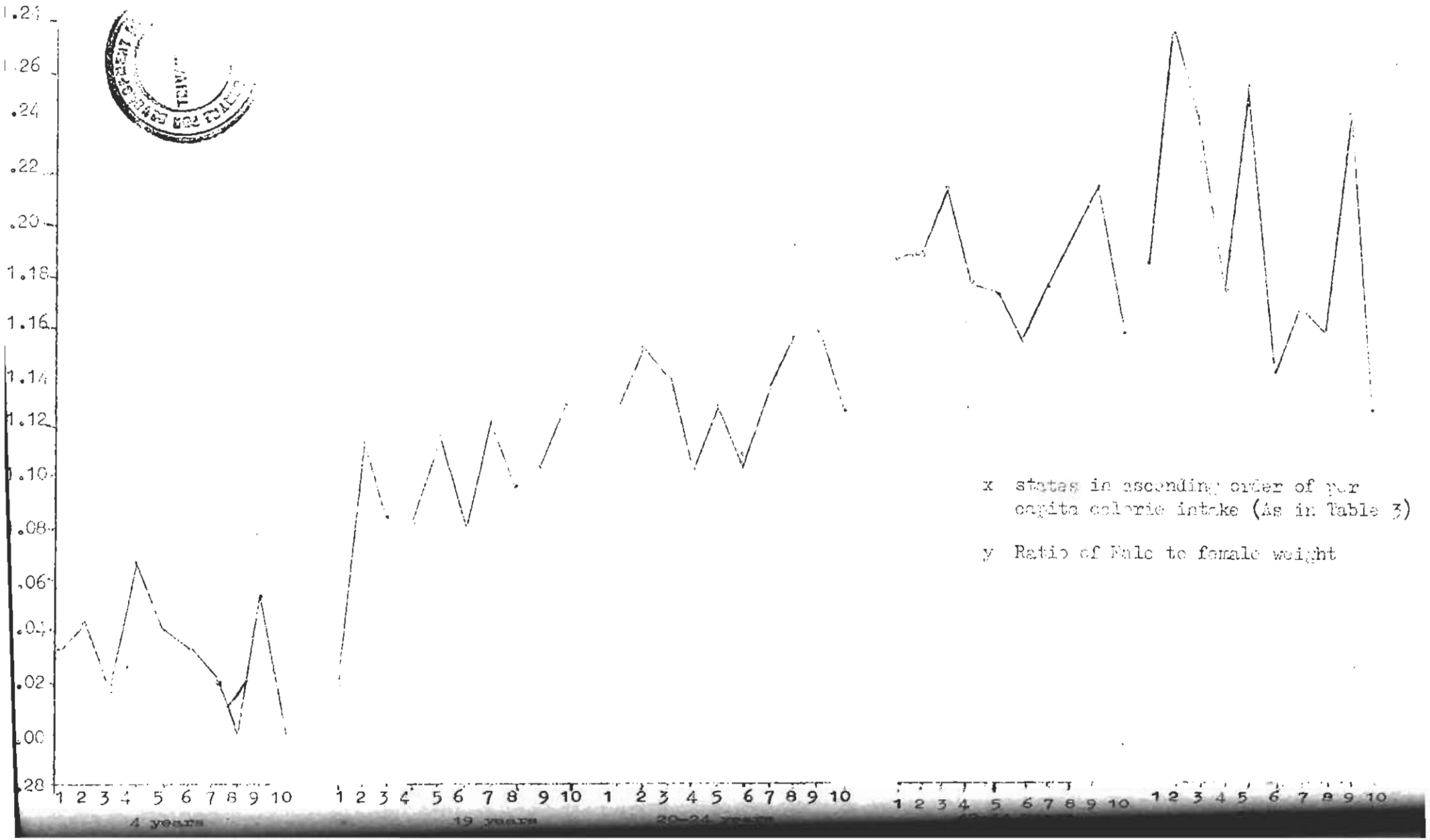
in both height and weight to fall. But during early adult hood (19 and 20-24 year group). The male-female disparity in size in fact tends to increase as one moves from states with low level of intake to those with relatively high levels. The expected tendency for the distance between male and female weight to decline with increase in mean intake is observable in any strength only the age group 55-59 years.

21. The picture is substantially similar if we consider the increments in male and female weight at different stages of life in relation to variation in overall mean food intake. We have already referred to the differences in the pattern of absolute weight changes among age-sex categories when mean calorie intake increases (Fig.3). The differential changes of male and female size and the fact that there is an age pattern to them are brought out more sharply in Fig.5 which plots the rate of weight change of males relative to females at different stages in various regions arranged by ascending order of mean calorie intake: It again shows that the male-female disparities in rates of weight gain tends to be greater in states with high levels of mean intake between 4 and 19 years of ages) and to be narrower in late middle age (40-44 to 55-59). The latter tendency would also seem to operate. Though in a less striking way, during the intermediate stages.

22. Whichever way one looks at it, the above data suggest that discrimination against females in intra-family food allocation is

neither universal nor does it always get accentuated when the family's food supply relative to its size is low and inadequate. There are indicationsof general discrimination against females in early childhood and late middle age and a tendency for it to weaken as men intake rises. But there is hardly any evidence of this in late childhood and adolescence. Indeed the fact that male-female disparities both in absolute weight and rate of weight change in the age group 4-19 years increase with mean intake suggests, if anything, to greater equality of treatment of the sexes in this age group in food allocation. If size differences in particular age-sex categories were mostly due to difference in food intake, the fact that weight of males is generally more sensitive to changes in mean intake than that of females of same age would imply that as the family food supply changes the amount allocated to males is varied much more than females but its degree varies greatly according to ages It seems that when family food supply increases from relatively low levels, the consumption of 4 to 19 and 19 to 20-24 year males increases most; variation in consumption of older males and of females in most ages relative to the fmaily consumption would seem much smaller in comparison. Intra-family distribution thus has both a sex and an age dimension which need to be considered jointly.

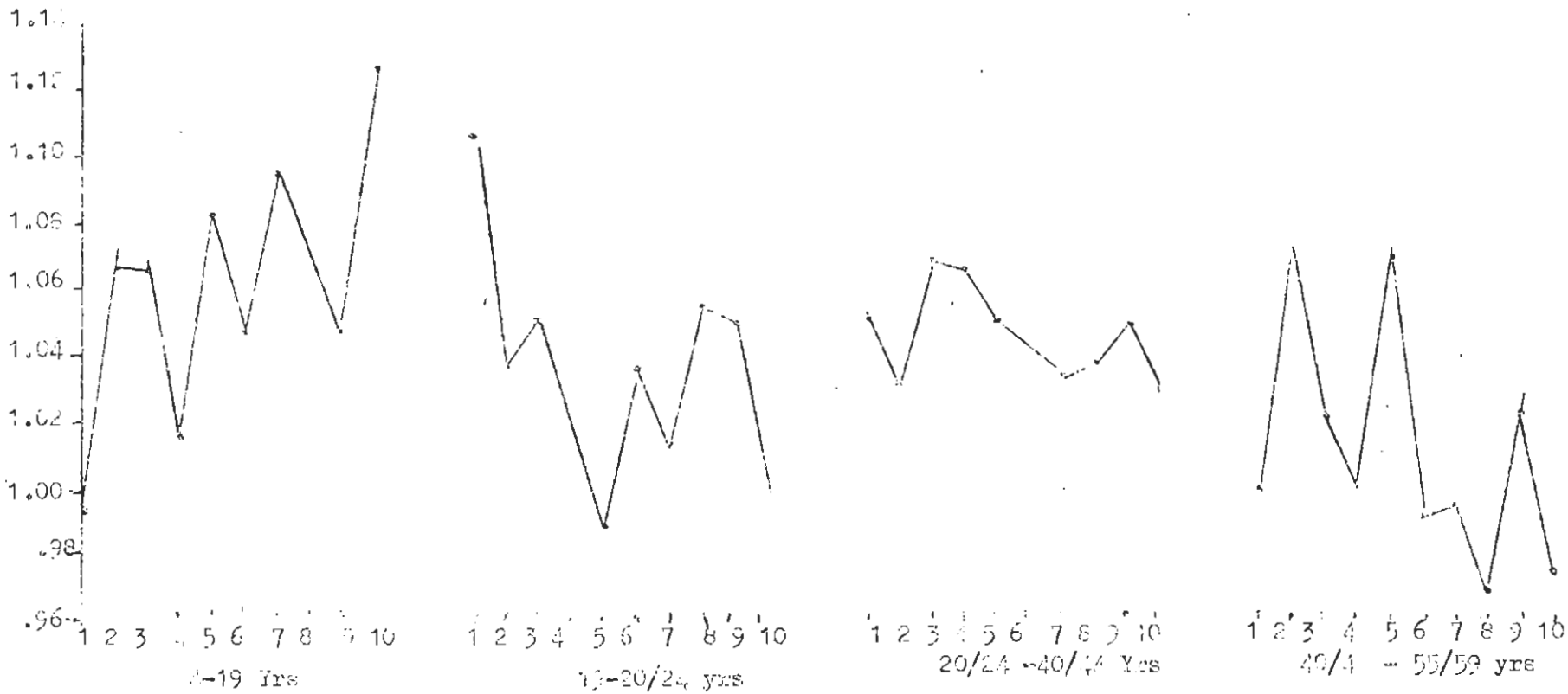
Figure 1 : Ratio of the Male to female weight in selected Age groups and states 1974-79



Relative rates of increase in weight among mates and females at different ages and mean caloric intake percapita

x states ranked in ascending order of mean percaput calorie Intake, 1971-73

y $\frac{\text{Weight of males at age n over weight at age m}}{\text{Weight of females at age n over weight at m}}$



23. It is possible ofcourse that the observed relation between relative size and overall mean intake is a reflection not only of differences in intra-family distribution, but also of systematic variation in other determinants of size with reference to overall mean intake; e.g., the kind of activity which females of different ages perform in a relatively poor region may differ systematically compared to those in the more prosperous areas; and it is possible that people in the low intake regions have adapted either by more efficient use of food or by lowering their activity level and/or work output per unit time. Given that changes in food intake could lead to adjustments on dimensions other than size, a more disaggregated study controlling for nature of activity, genetic factors and health environment is necessary for a better understanding of the age-sex differences in size-intake relation and their significant

24. In any case changes in nutritional status, being multi-faceted in nature, cannot be assessed definitively on the basis of changes in size alone. One also needs to know what changes in activity levels, productivity and morbidity have occurred. Since it is conceivable that a person (or a group) may show no change in size but may have altered his status in other respects, constancy of height and weight does not by itself indicate status-quo in nutritional status. Yet, the fact remains that a change in size is one important indication of a change in nutritional status. A fall in mean height and weight of a given age-sex group should be taken as deterioration in the nutritional status of that group even if all other indicators do not show any change.[13/]

25. The surveys conducted by the NIN provide a rare opportunity to examine whether there has been any systematic change in the average size of people aged 21 years and below in different parts of India and to ascertain their direction and magnitude. Data on mean height and weight by sex for ages 1-21 are available for 6 states. On the face of it they suggest that, in all states, average height and average weight of both sexes and at all ages in the late 1970's are lower than at the time of the first survey (1956-1965) the reduction in weight being more prominent than that in height (Table 6).

26. Differences in the scope and design of the two sets of NIN surveys, however, make it difficult to be sure whether the changes they indicate are real. Thus the published tabulations for the first survey relate to the combined sample for rural and urban areas, while for the latter period the estimates relate only to rural areas.[14] To the extent the people in urban areas tend to be taller and heavier than their rural counterparts, the fall in mean size may be at least in part statistical. There is some indication that there are indeed systematic differences in size between rural and urban areas, but it is not clear that their magnitude is so large as to vitiate the comparison.[15] This difficulty could be overcome if the primary data for the earlier survey were available and the mean height and weights could be estimated separately for the rural sample.

27. A second difficulty arises on account of differences in sampling design.[16] The earlier inquiry was based, in the urban areas, on a survey of children selected primarily through schools, supplemented by selection of non-school children in such a way that all sections are properly represented in sample. It is arguable that the sample may be biased in

Table 6

Ratio Mean heights and weights of males and females at the points of time[1/] as recorded in the NIN Surveys

State	Height (Cms)						Weight (Kg)					
	4		19		14	19	4		19		14	19
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1. Kerala	.962	.973	1.	1.004	.979	.976	.977	.989	920	.938	.995	.975	.941	.916	.930	1.036
2. Tamil Nadu	.985	.963	.981	.988	.984	.991	.993	.991	.970	.968	.971	.966	.941	.902	.931	1.007
3. Orissa	.984	.977	.935	.961	.965	.975	.985	.973	.932	.937	.852	.974	.889	.929	.961	.961
4. Andhra Pradesh	.989	.990	.982	1.003	.962	.982	.990	1.004	.985	.986	.953	.984	.865	.979	.989	1.017
5. Uttar Pradesh	.996	.996	1.003	1.002	.987	1.003	1.	.983	.962	.969	.982	.968	.921	.970	.980	.975
6. Madhya Pradesh	.980	.957	.981	1.000	.963	.985	.985	1.010	.885	.881	.919	.973	.879	.901	.975	.990

1) Average for 1974-79 as reported in ICMR, NIN (1980) and Mean values as reported in the 1956-65 Survey (ICMR, NIN 1972)

favour of relatively well-to-do groups for the simple reasons that the school going children, especially in states with low levels of enrolment, and everywhere in the high school age groups, are likely to be more from the upper income groups. Whether the supplementary selection succeeds in correcting this bias is a question which has to be examined.[17/] The more recent surveys on the other hand are based on more carefully designed sample of households which seems more likely to be representative of the population.

28. In so far as there is a bias towards children of well to-do families in the earlier survey, the height and weight of the children recorded in it would tend to have an upward bias. However, it is arguable that since attendance in lower classes is much more widespread than at higher levels the extent of this bias should be an increasing function of age. This means that the bias would affect the comparison at the higher age groups more than in the lower age groups. The existence of differential bias makes it difficult to be sure how far the observed changes are "real" how far "statistical". There is also the objection that in the absence of data on intake for different segments of the population, it is possible to relate observed changes in size to changes in food consumption. While this undoubtedly restricts the scope for analysis of the reasons for changes in size, and for differences across states and classes in this respect, the fact of change in height and weight is by itself of considerable interest.

29. Except for the question of bias in the urban sample and the difference in sample design, which need to be examined carefully, it would seem possible to get much useful information on changes in size from the two surveys if the original data could be retabulated to get

estimate of age and sex specific mean height and weight, (and their standard deviation) separately for (a) rural and urban areas; (b) broadly defined caste (in particular scheduled and non scheduled castes) and occupational groups (in particular cultivators and wage labourers); and (c) wealth status (in terms of say extent of land operated per member). This will give a better idea of the direction (if not the magnitude) of the changes in overall size across regions and sections of the population. It would also give us some idea of whether changes among scheduled castes, wage labourers and other segments comprising the lower range of the society differ significantly from other segments of society, and whether there are significant regional differences.

Conclusion

30. Being basically an exploratory effort and given the limited amount of empirical data with which we had to work, this paper has no definite conclusions to offer. Hopefully, however, the arguments and evidence marshalled above are sufficient to show that size of human beings being <u>one</u> of the major indicators of nutritional status merits closer attention; that differences in size are to some degree, perhaps to an important degree, a reflection of differences in sustained food intake; that the differences in the mean food intake as between households/groups do not affect the size of all age-sex categories uniformly, and that the intra-family distribution may be systematically related to the overall supply of food per capita but in ways considerably more complex than the hypothesis of purely sex-based discrimination would suggest. In all these respects, the evidence, gross as it is, seems

sufficiently suggestive to warrant more detailed analysis. The data from the nutrition surveys conducted by the NIN permit for more detailed examination of these questions, and also the question of whether there has been any systematic tendency for the mean size of people to fall especially in regions and classes which have experienced a declining trend in percapita food intake on the past 2 decades. The purpose of this paper would be amply served if it helps stimulate such detailed work.

Acknowledgement

I have benefitted from discussion with Chandan Mukherjee, Chiranjib Ashok Nag and specially, C.R. Soman who clarified my understanding of the effect of nutrition onsize and also went through an earlier draft. None of them, however, are implicated in any defects or errors which the paper may still have.

Notes

1. The evidence consists of (i) a close and continuous monitoring of activity and energy expenditure of some 54 males of roughly the same height and weight engaged in farming, and (ii) data on body weight and food intake of a group of women workers in a community kitchen with roughly the same level of productivity. The evidence suggests the relative efficiency of energy utilisation (measured by average work output per unit calorie intake) is inversely related to the level intake (Sukhatme, 1980:2013)

2. According to one recent estimate, the average annual growth in foodgrain production during 1953 to 1978 was below 2 percent in 4 States between 1968-69 and 1980-81, according to another estimate (Sawant, 1983) it was less than 2% in 8 states.

3. In all the 14 major states, per capita consumption expenditure at constant price of rural labour households in 1974-75 was lower than in 1963-64 (GOI, Labour Bureau, 1983)

4. Seckler (1979)

5. Sukhatme (1982): 2011,13) gives data relating to women workers in a community kitchen engaged in making chapatis to show that there is no relation between body weight and level of productivity.

6. The surveys conducted by the National Nutritional Monitoring Bureau did attempt to collect, by oral enquiry, data on the quantum of various foods consumed by individual members for a single day. Considering the well known difficulties of getting even the family's total intake by weighment, there is good reason to be skeptical of the information on individual intake obtained by interviewing the family members.

7. For example in a recent article Sen concludes on the basis of detailed data for 2 Bengal villages that there is a systematic sex bias" "reflected in higher rates of deprivation of girls vis-a-vis boys. The sex bias is reflected both in the greater prevalence of under nourishment of various degrees among girls than among and also (b) the lower growth dynamics of girls vis-a-vis boys" (Sen 1983:855) Sen's study is limited to children below 4 years of age and uses the deviation of actual from "normal" growth defined by ICMR as the index of malnutrition. He does not give any data on the food intakes of the villages or the sample families.

8. These estimates are available for 1971-72, 1972-73 and 1973-74 from Dasgupta (1982). The next survey of consumption was done only in 1978-79, the tabulation of which are not yet available. This difference in the base years for ranking the two sets of variables is thus dictated by the availability of data. In so far as the relative rankings of state by calorie intake are reasonably stable over time -- and it is interesting that the ranking based on 1961-62 data is broadly similar to the one for 1971-73 - the conclusions are not likely to be affected seriously.

9. Determining the age of each individual accurately is well known to be a major problem in such enquiries. The NIN surveys are quite conscious of this and the instructions to investigators emphasise the need for care in getting this information and also gives some hints for the purpose. While errors in age estimates are inevitable, so long as their incidence is random the survey data can be used to study the size-intake relation at different ages.

10. Strictly speaking it could be argued the height and weight of an individual at a given point are not only a function of his food intake level at that time but is a reflection, and the cumulative result, of the level and quality of intake over his entire life. However this seems much more relevant for height than weight. The latter, and even more so weight per unit height, would seem much more sensitive to the current level of intake. The need for more refined models of the nutrition-size relation is obvious enough though there are serious doubts whether the data necessary to test them are currently available.

11. The distribution around the mean is skewed and the extent of skewness varies between states. For instance Dasgupta (1982) estimated the gini coefficient of calorie intake to range from 1765 in West Bengal to .2650 in Kerala. This would not however affect the association between mean intake and size so long as the functional relation between the two is the same across individuals and populations - an assumption which may not be unreasonable. I am grateful to Chandan Mukherjee for clarifying this point.

12. Inequality between sexes in food distribution would also affect the coefficient of variation (CV). If females are discriminated against, the CV of female weight should be greater than CV for males; and if the extent of discrimination is inversely related to mean intake, the coefficient of variation of females relative to that of males should fall as intake rises. We find that while the CV in weight and height is in most regions and age categories higher for females, the relative CVs (which we compared only for weight) show no clear pattern except in the 40-44 age group where it declines as mean intake rises. However since the CV estimated from the sample data is affected by pooling of data over several ages in some cases and over five years (there are year-to-year variations and errors on account of sample size in individual years) and since

they are also affected by the extent of inequality in distribution across families (which varies), it may not be possible to be definitive on this aspect from the present data.

13. It seems rather unlikely that a decline in body weight will be accompanied by an improvement in productivity and or a switch to more strenuous activity.

14. During the earlier survey, a total 127,100 children were surveyed: 83,700 (approx) in urban areas and 43,400 in rural areas. (ICMR, 1972:11). The breakdown by states is not available. In the more recent surveys, about 400 households were sampled annually from rural areas of each state. The actual number varies somewhat from state to state. Thus in 1979 a total of 3533 households were surveyed for diet and nutrition in 10 states. The number in individual states ranging from 140 in Bengal to over 500 in Karnataka. (The total population of the sample HHs is close to 25,000 giving an average HH size of around 7). In any given year the number of observations in particular age-sex categories for individual states is small (rarely exceeding 50 and in several cases 10 or less). This is the reason why we decided to use the pooled data for 5 years.

15. The report on the first survey (ICMR 1972:34) says

> "It is observed that the mean values of height and weight of children belonging to urban areas were higher than those of children from rural areas throughout the growth period. However the differences were not statistically significant".

Note that while the estimates are subject to sampling error, and the difference for any age-sex category may not be statistically significant, the fact that the estimated mean size by sex and/or by residence is higher or lower across all age categories would suggest that there is a systematic difference in direction of change though not of its magnitude.

16. For the 1956-65 survey the primary sampling unit was the "eligible infant or child" defined as "an apparently normal infant or child aged 1 through 21 years who was resident in the area in the sense that it had spent the major part of its life there". Certain children (those bed-ridden for 15 days or more, those with deformities and chronic systemic disease) were excluded. Each Survey unit (there were 7 of them, roughly one for each major state) was expected to survey 20,000 children distributed in the ratio of 5:3 between urban and rural areas. There was a different sampling procedure for rual and urban areas. In rural areas there were three stages of selection, namely, districts, villages and households. Roughly one out 200 villages in the selected zones was surveyed, with villages being classified into 2 strata according to size. "All eligible

children in the selected village were included in the sample. Children were asked to assemble in the village school or some essential place in the village for clinical examination and body measurement" (ICMR:1977:4)

Urban areas were stratified by size and a designated number chosen from each. "The sampling frame for children going to school was a list of schools in the town/city. A systematic sample of schools was selected and from each school a random sample was chosen. Pre-school and non-school going children were also included and examined in their homes (ibid). The exact procedure for selecting the last category is not quite clear from the report; nor is it clear whether the 5-15 age group is confined to school going children.

In the NNMB surveys, (See ICMR, NIN:1975) the sampling for rural areas is done in three stages: namely districts, villages and households All districts in each state one classified into 4 groups according to the level of development and one from each selected randomly. Within each district villages are grouped into 3 categories according to size. The numb of sample villages in each category is determined on the basis of their rela shares in rural population of the district and the number of households to be surveyed. The villages are selected randomly from each stratum. "On the selection of households in each village, proper representation must be given to the different segments of the population (Harijans, low income groups, middle income groups and high income groups) so that the pooled estimation based on all the households surveye..gives us reliable information regarding the dietary status of the village as a whole. The selection of the household will be done by the team on the spot by random sampling after consultation with the village head" (ibid:12)

17. Note that in the case of rural areas, where the sampling procedure call for measurements in respect of all children in the selected village, which are themselves based on a stratified random sampling procedure bias should not be a problem in the first round of surveys. Nor do the available description of the procedures adopted in NNMB surveys give any ground for expecting any sampling bias.

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